Information Flow and Processing Analysis Report

Human Factors Engineering System Analysis of CF18A Air to Ground Operations

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Executive Summary

This report marks the third in a series of Human Factors Engineering (**HFE**) reports prepared for the Defence and Civil Institute of Environmental Medicine (**DCIEM**) in support of the Directorate of Aerospace Requirements (**DAR 5**) for the Department of National Defense (**DND**). The objective of this Information Flow and Processing (**IFP**) Analysis of the CF-18A in the Air to Ground mission is to establish a baseline of information that will be used to assess the impact of Helmet Mounted Display (**HMD**) and Night Vision Imaging System (**NVIS**) technologies and the flow of information in the cockpit of the Modernized CF-18A.

This report documents the findings of the HFE IFP Analysis of the CF-18A in an Air to Ground Role in accordance with the Statement Of Work (**SOW**), Public Works and Government Services Canada (**PWGSC**) Requisition No. W7711-017741. While the analysis follows the general principles and guidelines for HFE as described in MIL-HDBK- 46855 "Human Engineering Program Process and Procedures", the IFP analysis presented here is non-traditional in that it is not being used to analyze critical mission segments as a whole, but instead it is being used to analyze each task of the six critical mission segments identified in the previous Systems Analysis Report.

The Information Flow and Processing Analysis Report presented here details the background research done, the data collection methodology employed, and the results obtained.

For the purposes of this study, the assumed air vehicle was the post CF-18A in its' modernized aircraft configuration, with avionics sub-systems, weapons systems and Defensive Electronic Warfare Suite (**DEWS**). The assumed air vehicle incorporated the CF-18A Incremental Modernization Program (**IMP**) and Capital Program initiatives described in the Mission Analysis Report, The HFE Group Document # 42-014-001. Although the CF-18A HMD will be an integral part of the CF-18A modernization, for the purpose of establishing an initial reference database, it was not included as part of the assumed air vehicle.

As a separate task, a document will be produced detailing the structure of the Access database employed for the gathering and printing of the data.

This series of reports form a body of knowledge that can be referenced by DND staff and contractors to guide or justify CF-18A design decisions that concern human factors and system performance. This information flow and processing report, in particular, provides valuable insight to analysts about the CF-18A pilot's goals and actions, providing a consistent reference upon which to base judgments on competing design concepts.

Sommaire Exécutif

Ce rapport est le troisième d'une série de rapports sur la psychologie industrielle (**PI**) préparé pour l'Institut de la Médecine Environnementale pour la Défense (**IMED**) à l'appui du « Directorate of Aerospace Requirements » (**DAR 5**) pour le service du Département de la Défense Nationale (**DDN**). L'objectif de cette analyse de l'écoulement et du traitement de l'information du CF-18A dans les missions Air-Sol est d'établir une ligne de base d'information qui pourra être utiliser dans les buts suivants:

a- Évaluer l'impact des technologies Helmet Mounted Display (**HMD**) et Night Vision Imaging System (**NVIS**); et

b- Évaluer l'information dans le poste de pilotage du CF-18A modernisé.

Ce rapport documente les résultats de l'analyse de la psychologie industrielle du CF-18A dans les rôles Air-Sol selon le rapport de travail (RDT), Travaux Publics et Services Gouvernementaux Canada (**TPSGC**) numéro W7711-017741. Tandis que cette analyse suit les principes généraux et directives pour la psychologie industrielle comme décrite dans MIL-HDBK- 46855 "Human Engineering Program Process and Procedures", elle n'est pas une analyse traditionnelle. Couramment une analyse de l'écoulement et de la traite de l'information est utilisée pour analyser les segments critiques de mission dans l'ensemble. Dans ce cas-ci, cette analyse est utilisée pour étudier chaque tâche des six segments critiques de mission identifié dans le rapport d'analyse des systèmes précédents.

Le rapport d'analyse de l'écoulement et du traitement de l'information ci-joint décrit la recherche d'arrière-plan, la méthodologie de la collection de données, et les résultats obtenus.

Pour les buts de cette étude, le véhicule choisi fût le CF-18A dans sa configuration modernisée, avec des sous-ensembles avioniques, des systèmes d'armes et une suite défensive de guerre électronique. Ce véhicule incorpore le programme de modernisation graduel du CF-18A et les initiatives du programme capital telles que décrites dans le rapport de l'analyse de mission (Document # 42-014-001 « The HFE Group »). Bien que le CF-18A HMD fût une partie intégrale de la modernisation du CF-18A afin d'établir une première base de données de référence, elle ne fût pas intégrer au véhicule d'air choisi.

Comme tâche à part, un document sera produit détaillant la structure de la base de données d'Access(MC) utilisée pour la collecte et l'impression des données.

Cette série de rapports serait un bon guide de référence pour le personnel et les contracteurs de DDN pour justifier les décisions de conception du CF-18A en ce qui concerne les facteurs humains et la performance du système. Ce rapport d'analyse de l'écoulement et de la traite de l'information fournit une perspective valable aux analystes tant qu'aux buts et aux actions des pilotes du CF-18A. De plus, ceci fournit une référence cohérente sur laquelle juger les concepts de design concurrents.

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Acknowledgements

This Information Flow and Process Analysis Report expands upon an initial study conducted by BAE Systems, now CMC Electronics Inc. and makes maximum reuse of much of the methodology contained within the CF188 APG-65 Radar Human Factors Engineering Study Reports published between May 2000 and December 2000 (Contract Serial Number W7714-9-0281). To avoid unnecessary repetition of methodology descriptions, the reader is referred to the corresponding CMC document containing the detailed description.

The Microsoft Access Database used to facilitate data entry and produce the required reports was provided to The HFE Group by DCIEM as Government Furnished Information (**GFI**). The database was originally developed by Mr. Mike Wellwood under sub-contract to CMC and has been used successfully on many Human Factors projects. The database provided was highly modified to meet the project specific needs of this analysis and has been delivered back to DCIEM for use on future projects.

Introduction

General

The Directorate of Aerospace Requirements (**DAR 5**) is in the process of upgrading the CF-18A to maintain its technical currency over the next 20 years. Part of this upgrade will be the inclusion of a Helmet Mounted Display (**HMD**) with a Night Vision Imaging System (**NVIS**) capability.

As the use of HMD and NVIS technologies in the CF-18A represent new ways of performing old tasks, it was determined essential to establish how this technology would be used and to document the flow of information in the cockpit. The Defence and Civil Institute of Environmental Medicine (**DCIEM**) has undertaken an investigation of HMD and NVIS technologies in order to provide DAR 5 with advice on human factors issues that may arise from their use in the CF-18A. The investigation will focus on the Air to Ground role of the CF-18A as this is the most likely role in NATO and coalition activities. The Air to Ground role of the CF-18A also presents a high cognitive demand on the skills and abilities of the pilot.

The present report constitutes the third in a series of reports in support of DCIEM's investigation of HMD and NVIS technologies. The first report, Mission Analysis Report: Human Factors Engineering System Analysis of CF-18A Air to Ground Operations, provided background information for placing the CF-18A modernization program into context, a description of the expected post Incremental Modernization Project (**IMP**) CF-18A, and a composite mission scenario. The second report, Systems Analysis Report: Human Factors Engineering System Analysis of CF-18A Air to Ground Operations, detailed a series of Human Factors Engineering (**HFE**) studies performed using the description of the post modernized aircraft from the Mission Analysis report. The present report, Information Flow and Processing Analysis Report: Human Factors Engineering System Analysis of CF-18A Air to Ground Operations, builds on the Systems Analysis report by providing a non-traditional information flow and processing (**IFP**) analysis of each goal at each functional level of each critical mission segment identified in the Systems Analysis. When combined, these three reports will serve as a baseline of information that can be used in assessing the implications of employing HMD and NVIS technologies in the CF-18A.

Purpose

The IFP analysis detailed in this report provides a non-traditional information flow and processing analysis of the six critical mission segments identified in the previous Systems Analysis Report. Through the use of this technique, not only are the individual task requirements typical of a conventional HFE analysis documented, but also the upward flow of information to support higher-level goal achievement.

Objectives

The objective of the project was to perform a non-traditional IFP analysis of a CF-18A pilot's activities during of the six critical mission segments of the Air to Ground mission as defined in the previous Systems Analysis Report.

Scope

The IFP Analysis Report may be read as a standalone analysis of the employment of the CF-18A during specific activities (e.g. daytime general purpose bomb attack) performed as part of the Air to Ground mission, but is better understood when put into context and reviewed after reading the Mission and Systems Analysis Reports. When combined with these reports, the IFP Analysis Report provides the project manager with a baseline of information that can be used to assess the impact of HMD and NVIS technologies and their impact on the flow of information in the cockpit of the Modernized CF-18A, as well as provide support to future modelling activities.

Report Organization

The report is organized into the following six sections:

a. Section One – Introduction. Section One provides background information, the purpose and objective of the analysis, and the scope and organization of the report.
b. Section Two – Information Flow and Processing Analysis. Section Two provides background information on IFP analyses in general, the database used to record and print the data gathered, and a discussion of the data gathering methodology employed.
c. Section Three – Conclusion.
d. Section Four – References.

Annex A – Glossary of Terms and Acronyms.

Annex B – Information Flow and Processing Analysis Results

Information Flow and Processing Analysis

General

The information flow and processing (**IFP**) analysis constitutes a key element of any HFE effort. Traditionally, IFP analyses are used to analyze the critical mission segments of an operational sequence diagram (**OSD**) as a whole, while also looking at other criteria such as the consequences of error and impact on situational awareness. In contrast, the present IFP analysis looks at each goal separately, thereby providing the finer degree of resolution required by the project's scope. It is for this reason that the IFP analysis documented here is considered non-traditional.

In compliance with the statement of work (**SOW**), the IFP analysis involved gathering the following data for each task in the six critical mission segments identified in the Systems Analysis Report:

a) The information required to achieve each goal;

b) The decision(s) required to achieve each goal;

c) The source(s) of the information required to achieve each goal;

d) The type and source of feedback required to know that a goal has been achieved;

e) The type of reasoning required to achieve each goal;

f) Factors that influence the achievement of goals in various scenarios of the original HFE analysis;

g) The physical actions required to achieve each goal; and

h) The level of precision or accuracy required in both the reasoning and physical actions of each goal as well as how the precision may very in different phases of the scenarios.

Database

To facilitate the gathering and printing of the data presented in Annex B, a Microsoft Access database was used. It was tailored to the needs of the present analysis through the addition of two new tables and one new form. For a complete description of the database, please refer to the following document "Information Flow and Processing Database Description, DCIEM #CR2001-165", available from the scientific authority (SA).

Data Population Method

Discussion with Scientific Authority

Following receipt and review of the SOW, clarification was sought on several points. A walkthrough of each criterion was conducted to ensure the expectations of the SA were being met. One area that stimulated much discussion was the use of Rasmussen's "Skill, Rule, Knowledge" categorisation which was employed to assess the level of reasoning required to achieve a particular goal. Verbal anchors for each reasoning category were established with the SA and used throughout the project.

Background Research & Supporting Material

Internet Research

Before proceeding with the data population, background research was done on the Internet to provide familiarisation with the history of the CF-18A modernization program, and the different Air to Ground weapons that the modernized aircraft is expected to carry. Research was also done on modern aerial bombing.

F/A-18 Video Game

To provide a feeling for what the cockpit of the modernized CF-18 may look like, Jane's Combat Simulations' F/A-18 Flight Simulator was used. The simulator was also used to conduct cognitive walkthroughs with the SME. This PC flight simulator is based on the US Navy's F/A-18E Super Hornet. Although there are likely to be numerous differences between the modernized CF-18A and the F/A-18E, particularly when considering that the former is to be a modernized version of the original F/A-18A while the latter is for all intents and purposes a new aircraft, there are never-the-less sufficient similarities in areas such as weapons carried, and the general position of displays in the cockpit, to allow an F/A-18E simulator to stand-in-for the modernized CF-18A. Figures 1 and 2 show the inside of the F/A-18 cockpit.

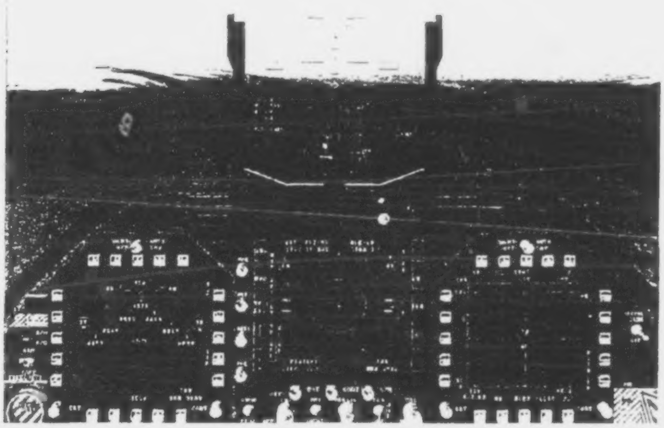

Figure 1: Head forward view of F/A-18E cockpit

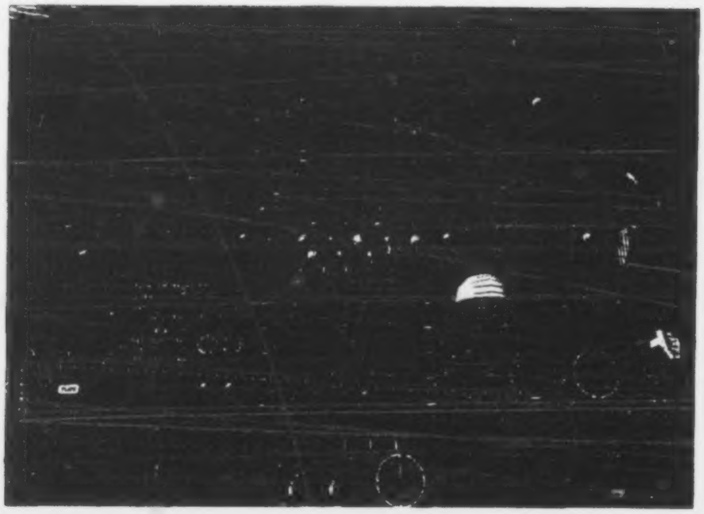

Figure 2: Head down view of F/A-18E cockpit view

The F/A-18E simulator proved particularly useful for ensuring that the Subject Matter Expert (SME) and researchers understood each other when discussing aspects of the modernized CF-18A cockpit.

Previous Study

As stated earlier, the present IFP analysis builds upon a previous Systems Analysis of the modernized CF-18A in the Air to Ground mission. One of the components of that analysis was the production of an OSD from the composite mission scenario laid out in the preceding Mission Analysis Report. From these OSDs, six critical mission segments were identified and served as the basis for the present IFP analysis. Also as stated earlier, an existing Access database was used to gather the data and for producing the reports.

Process

To ensure that the data was populated in an efficient and thorough manner, a process was established for use by the entire data population team.

The following diagram illustrates the process used to complete the analysis.

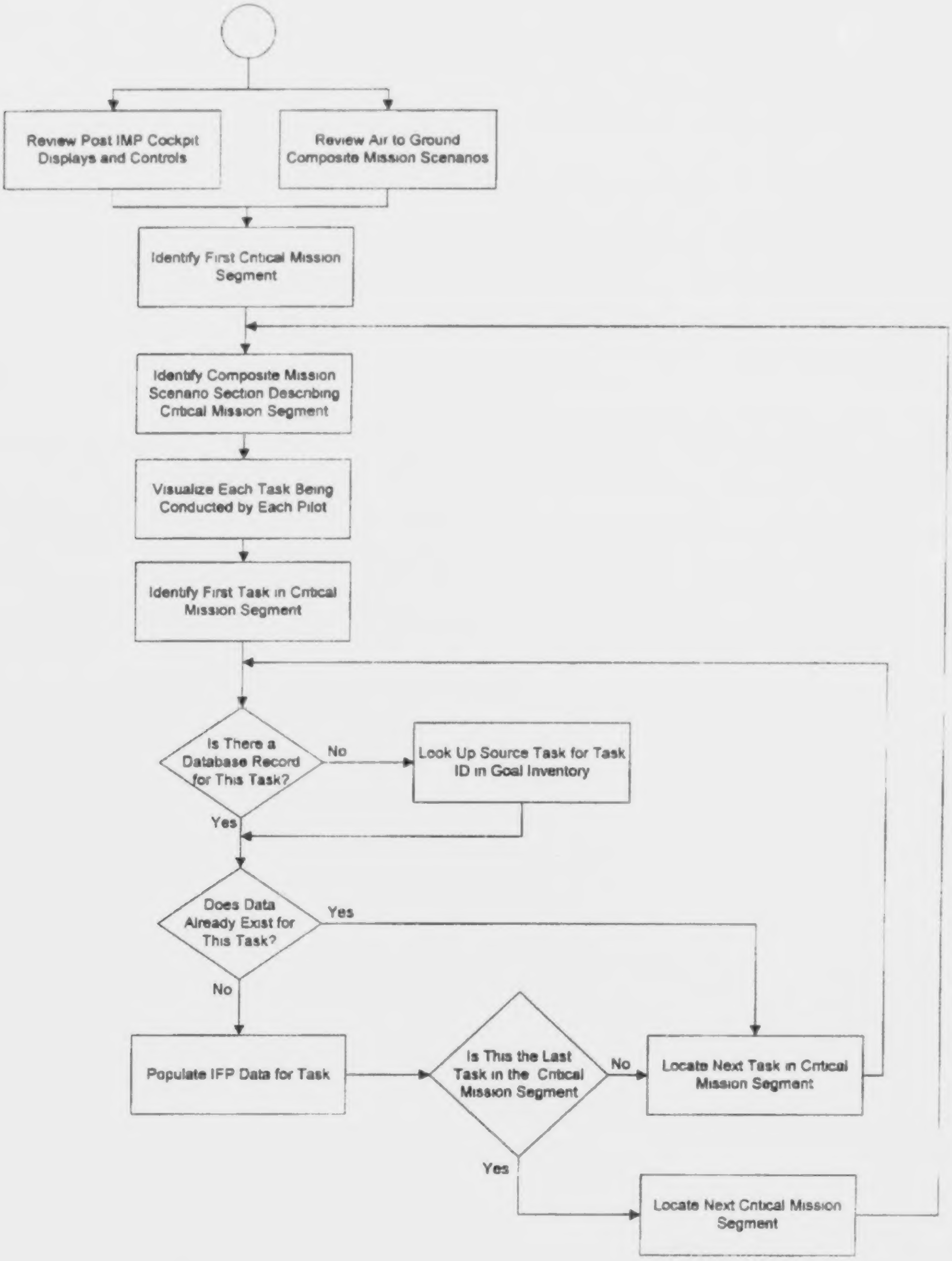
Review Post IMP Cockpit Displays and Controls
Review Air to Ground Composite Mission Scenarios
Identify First Critical Mission Segment
Identify Composite Mission Scenario Section Describing Critical Mission Segment
Visualize Each Task Being Conducted by Each Pilot
Identify First Task in Critical Mission Segment
Is There a Database Record for This Task?
No
Look Up Source Task for Task ID in Goal Inventory
Yes
Does Data Already Exist for This Task?
Yes
No
Populate IFP Data for Task
Is This the Last Task in the Critical Mission Segment
No
Locate Next Task in Critical Mission Segment
Yes
Locate Next Critical Mission Segment

Figure 3: Data Population Method

Initial Working Group Session

An initial working group session was held at The HFE Group with the SME. At this meeting, the data to be gathered by the analysis was reviewed and sources for this information identified using the Human Factors experience of the researchers and the CF-18A flying experience of the SME. The sources are listed below following their respective inquiry type:

a) The information required to achieve each goal.

The initial information required to populate this field was gathered from the declarative and situational knowledge of the PCT goal data populated in the previous Systems Analysis Report. In addition to this abstract knowledge information, a detailed analysis of each critical task was performed to identify the additional information that will be required by the CF-18 pilot to achieve each goal.

b) The decision(s) required to achieve each goal.

This information is determined by the SME based on the analysis of each goal description and the decisions involved in the process of achieving each goal. The information was also based on the data entered for points (a) and (c) as well as the SME experience.

c) The source(s) of the information required to achieve each goal.

Information is determined based on the data entered for point (a), combined with an analysis of the most likely sources to retrieve the information to be used by the CF-18 pilot in each specific situation.

d) The type and source of feedback required to know that a goal has been achieved.

The SME was instructed by the researchers to frame his response to the part of this inquiry relating to the type of feedback required to know that a goal has been achieved, and the source of such feedback, using the following four options: visual, auditory, cognitive, and psychomotor.

e) The type of reasoning required to achieve each goal.

The SME was instructed by the researchers to frame his response to this inquiry using the following three options: skill, rule, and knowledge. These options correspond to Rasmussen's "Skill-Rule-Knowledge" categorization. The following examples were provided to the SME to illustrate these options:

1. Skill: sensory-motor performance; without conscious control; automated, high-integrated.

2. Rule: based on stored procedures; induced by experience or learned; problem solving/planning.
3. Knowledge: in unfamiliar situations; explicitly think up a goal; develop a plan by selection; try it and see if it works.

f) Factors that influence the achievement of goals in various scenarios of the original HFE analysis.

A list of the most important factors influencing the achievement of each goal was created and is based on relevant information not captured by the other inquiries, along with amplification and nuances of some of the information already part of the IFP data.

g) The physical actions required to achieve each goal.

This information originates from the SME's experience flying the CF-18A and is based on the description of the goal that is being analysed. Each physical action that will be performed in the modernized CF-18A is described in the normal sequence of events.

h) The level of precision or accuracy required in both the reasoning and physical actions of each goal as well as how the precision may vary in different phases of the scenarios.

This proved to be a very difficult inquiry to respond to, requiring two rounds of feedback from the SA before the exact type of data sought was established. The primary method used to describe the level of precision or accuracy was to assign a quantitative range value whenever possible. Where this was not possible, the SME assigned a value corresponding to the amount of time required to achieve the desired level of precision or accuracy while attending the goal.

Following the review of the type of data to be gathered, the SME completed data entry for the first task thereby enabling the work to be reviewed to ensure that the data being gathered was consistent with the requirements of the analysis as laid out in the SOW. A conference call was then placed to the SA and the data gathered for the first task was discussed. The SA requested that any data gathered dealing with the level of precision or accuracy required to perform a task be framed with an explanation of the reasoning involved in addition to being rated as either high, medium, or low. The SME was then left to populate the database.

Preliminary Data Review with SA

The results were checked following the completion of the first eight tasks to ensure that all the required data had been entered. They were then converted to Portable Document Format and sent to the SA for review.

Clarification and Re-Scoping of Verbal Anchors

The SA returned feedback on the first eight completed tasks. The SA requested that any data gathered dealing with the level of precision or accuracy required to perform a task include quantitative ranges of values whenever possible. The SA's requests were relayed to the SME and the primary method used to describe the level of precision or accuracy by the SME was to assign a quantitative range value as per the SA directions.

Data Population and Verification

The SME completed data entry and returned the database to The HFE Group at regular intervals. The results were checked to ensure that all the required data had been entered, and printed in report format.

Preparation of IFP Analysis Report

An initial draft of the IFP Analysis Report, along with a printout of the fully populated database was produced and delivered to the SA for review. The draft was also sent to the SME for review and modification. Upon its return to The HFE Group, the comments received from the SA were incorporated into the final report. This was delivered to the SA as per the SOW.

Conclusion

A non-traditional Information Flow and Processing Analysis was conducted on the six critical mission segments of the CF-18A Air to Ground mission identified in the Systems Analysis Report. The project was completed under an extremely aggressive schedule of just 40 working days due to the limited budget. The ability to re-use much of the information provided by DCIEM to The HFE Group team along with a very focussed method allowed the project to be completed on time and within budget. Due to the budget restrictions imposed on the program, the report does not provide an exhaustive description of the method employed. What it does provide however, is an in depth analysis of the most critical mission segments of the CF-18A Air to Ground mission.

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Glossary

24/7	24 hours a day, 7 days a week
A/A	Air-to-Air
A/G	Air-to-Ground
AAA	Anti-Aircraft Artillery
AAR	Air-to-Air Refuelling
ABC^3	Airborne Battlefield Command, Control and Communications
AC	Alternating Current
ACDVS	Aircrew Chemical Defence Ventilator System
ACM	Air Combat Manoeuvring
ACM	Airspace Control Measures
ACO	Airspace Coordination Order
ADF	Automatic Direction Finder
AGL	Above Ground Level
AI	Air Interdiction
ALSE	Advanced Life Support Equipment
AMIRS	Advanced Multi-Role Infrared Sensor
AMLCD	Active Matrix Liquid Crystal Display
AMRAAM	Advanced Medium Range Air-to-Air Missile
AOB/GOB/EOB	Air, Ground and Electronic Orders of Battles
ASL	Above Sea Level
AST	Air-to-Surface Tactics
ATO	Air Tasking Order
AWACS	Airborne Warning and Control System
BCA	Border Crossing Authority
BDA	Bomb Damage Assessment
BST	Boresight Mode
CAMAO	Combined Allied Military Air Operation
CARD	4 Ship Tactical Formation
CAS	Close Air Support
CAS PG 2000	Chief Air Staff Planning Guidance 2000
CAVOK	Ceiling and Visibility OK (Clear Weather)
CCC	Command, Control and Communications

CCIP	Constantly Computed Impact Point
CD	Counter Drug
CF	Canadian Forces
CFIT	Controlled Flight Into Terrain
CMC	CMC Electronics Inc.
CMDS	Counter Measures Dispensing System
CONOPS	CONcept of OperationS
CP	Contact Point
CR	Combat Ready
D/L	Data Link
DAR	Directorate of Air Requirements
DC	Direct Current
DCIEM	Defence and Civil Institute of Environmental Medicine
DCS	Digital Communication System
DDIs	Digital Display Indicators
DEWS	Defensive Electronic Warfare Suite
DFFG	Deep Fathom Fishing Grounds
DIST	Distance
DMPI	Desired Mean Point of Impact
DND	Department of National Defence
DSTA	Director Science & Technology, Air
ECCM	Electronic Counter-Counter Measures
ECM	Electronic Counter Measures
ECS	Environmental Control System
EFUZ	Electronic Fuse
EGI	Embedded Global Positioning/Inertial Navigation System
EGR	Embedded GPS Receiver
ELE	Estimated Life Expectancy
F/A	Fighter Attack
FAC	Forward Air Controller
FAOR	Fighter Area of Operational Responsibility
FLIR	Forward Looking Infra-Red
FLOT	Forward Line of Own Troops
FM	Frequency Modulation

FPTD	Fighter Pilot Training Directive
FRAG	Fragmentation
FSU	Former Soviet Union
GP	General Purpose
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
G/S	Ground Speed
HAS	Hardened Aircraft Shelter
HDD	Head-Down Display
HF	Human Factors
HFE	Human Factors Engineering
HMD	Helmet Mounted Display
HMS	Helmet Mounted Sight
HOBS	High Off Boresight System
HOTAS	Hands-On-Throttle-And-Stick
HSD	Horizontal Situation Display
HUD	Heads-Up Display
HVAA	High Value Airborne Asset
Hz	Hertz
IAD	Integrated Air Defence (IAD) System and SAM: SA-6, SA-7, SA-8, SA-11, SA-13, SA-14 and SA-16
IAW	In Accordance With
IDENT	Identification
IFF	Identification Friend-or-Foe
IFP	Information Flow and Processing
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IMP	Incremental Modernization Project
INS	Inertial Navigation System
INST	Instantaneous
INU	Inertial Reference Unit
IP	Initial Point
IPME	Integrated Performance Modelling Environment
IR	Infra-Red

JDAM	Joint Direct Attack Munitions
JFC	Joint Force Commander
JSOW	Joint Stand Off Weapon
KIAS	Knots Indicated Air Speed
Lat/Long	Latitude and Longitude
LGB	Laser Guided Bombs
LOS	Line of Sight
LST	Laser Spot Tracker
MAG BRG	Magnetic Bearing
MAND ATTK HDG	Mandatory Attack Heading
MANPAD	Man-Portable Air Defence
MAV	Maverick
MCs	Mission Computers
MDG	Multi-purpose Display Group
MDLS	Mission Data Loading System
MFFOs	Mixed Fighter Force Operations
MHz	Megahertz
MIDS	Multi-functional Information Distribution System
MIL	Military Power
MIL-HDBK	Military Handbook
MILSATCOM	Military Satellite Communications
MOEs	Measures of Effectiveness
MOS	Maximum Operating Surface
MRI	Multiple, Release, and Interval
MSI	Multi-Sensor Integration
MSL	Mean Sea Level
NATO	North Atlantic Treaty Organization
NCTR	Non-Cooperative Target Recognition
NFOV	Narrow Field of View
NLT	No Later Than
nm	Nautical miles
NORAD	North American Air Defence
NVGs	Night Vision Goggles
NVIS	Night Vision Imaging Systems

OAS	Offensive Air Support
OEM	Original Equipment Manufacturer
OFP	Operational Flight Program
OPFOR	OPposing FORces
OSDs	Operational Sequence Diagrams
PC	Personal Computer
PGMs	Precision Guided Munitions
PIREP	Pilot Report
PPS	Precise Positioning Service
PRF	Pulse Repetition Frequency
psi	Pounds per square inch
PSKE	Pilot Skill and Knowledge Element
PSKL	Pilot Skill and Knowledge Level
PTLL	Pilot Tactical Leadership Level
PWGSC	Public Works and Government Services Canada
REF PT	Reference Point
ROE	Rules Of Engagement
ROZ	Restricted Operating Zone
RTB	Return To Base
RV	Rendezvous
RWR	Radar Warning Receiver
RWS	Range While Search
SA	Scientific Authority
SAM	Surface-to-Air Missile
SAR	Semi Active Radar
SATCOM	Satellite Communications
SHORAD	Short Range Air Defence
SITREP	Situation Report
SLOC	Sea Lines Of Communication
SME	Subject Matter Expert
SMS	Stores Management Set
SOPs	Standard Operating Procedures
SOW	Statement Of Work
SPS	Standard Positioning Service

SRAAM	Short Range Air-to-Air Missile
STT	Single Target Track
SVs	Space Vehicles
TACAN	Tactical Air Navigation
TAOC	Tactical Air Operations Centre
TAS	True Air Speed
TC	Transit Corridor
TCCCS	Tactical Command, Control and Communication System
TDC	Target Designator Control
TGT	Target
TOF	Time Of Flight
TRP	Tactical Rendezvous Point
TWS	Track While Scan
UDFs	User Data Files
UFC	Up-Front Controller
UHF	Ultra High Frequency
UN	United Nations
US	United States
USMC	United States Marine Corps
USN	United States Navy
UTM	Universal Transverse Mercator
VACQ	Vertical Acquisition Modes
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	VHF Omni-Range
VS	Velocity Search
WACQ	Wide Acquisition
WFOV	Wide Field of View
WVR	Within Visual Range
WYPT	Waypoint
XEFZ	Xarian Economic and Fishing Zone
YFR	Yearly Flying Rate
Z	Zulu

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2 1(b) **Goal:** Identify Initial Point Visually **Source Task:** 7 2.2 1(b)

Description:

Look out and identify large features that help you to identify smaller features that make IP unique Identify IP visually as you over fly it. Compare the visual image with the pre-studied Map of the IP or with the memorized image of the features identifying the IP

Information required to achieve goal:

Pattern recognition, key features to identify ground patterns visually.

Specific Initial Point features (e g terrain, large features surrounding IP, smaller unique IP features, weather, etc).

Aircraft altitude, heading, attitude, and speed.

Distance from IP, run in direction.

Target designation symbol (TD diamond)

Representation of IP on MAP

Source of information required to achieve goal:

HUD· Aircraft altitude, heading, attitude, and speed Distance from IP, run in direction. Target designation symbol (TD diamond)

Visually: Specific Initial Point features (e g terrain, large features surrounding IP, smaller unique IP features

Maps Representation of IP on MAP

Decision(s) required to achieve goal:

Decide to transition from searching for IP to Identifying IP

Decide to look specifically at the IP details that will help identify it

Decide that the Feature identified is the IP

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

From the information provided by intelligence, the pilot has to visualise and memorize the IP specific features. He then has to precisely associate the features presented to him to his memorized image of the IP, and then identify the IP with high level of confidence (hence high precision) Typically has to recognize 2-3 distinct features for IP Identification This reasoning can take 2-5 sec For Target ID, the pilot typically has to recognize 2-3 distinct features, and the reasoning can take 3-6 sec due to the less obvious features of certain targets. In reality, the pilot typically only has a few seconds 1-3 to ID the target, making this task very demanding at times

Physical action(s) required to achieve goal:

Look at displays

Look out

Look at Maps

Level of precision/accuracy required to perform the preceding action(s):

Medium

The pilot has to look precisely at the displays and at the Maps to get the information required His look out towards the IP has to be precise in focus distance, as well as in the specific location where he is looking

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Ground Surroundings (Visual)

HUD

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

IP significant features
Familiarity with type of IP
Time of day
Contrast with surroundings
Range
Position of IP with respect to pilot
Aircraft precision at displaying IP location
Environmental factors

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2 1(c) **Goal:** Designate/Add Offset at Initial Point **Source Task:** 7 2 2 1(c)

Description:

Over fly designation First, ensure you are in NAV or A/G Master mode, then assign the TDC to the HSD Anticipate over fly of IP using external visual references Depress the TDC when you are accurately positioned over the point you want to designate If the wypt you have selected at the time happens to be an OAP (has offset data entered) then the MC assumes that you are overhead the OAP and automatically adds the offset information to the designation This only takes place for an over fly designation Confirm that the Target Wypt, distance and heading are displayed in the HUD and that they are accurate

Sensor designation. First NAV designate the IP (or Offset aim point) With the TDC assigned to the desired display (Radar or the AMIRS), the designation is then adjusted by moving the TD diamond or the NAV stabilized cursor designation When satisfied that the designation is accurately on the IP (or Offset point) add O/S (Pre-programmed) by depressing the appropriate push button on the HSD Confirm that the Target Wypt, distance and heading are displayed in the HUD and that they are accurate

Information required to achieve goal:

Aircraft operating procedures Standard Operating procedures Designation procedures

Mission requirements and objectives Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc) Details of on-going or planned activities

Aircraft Master mode selection, TDC assignment location,

IP location

Target Wypt information, distance and heading

Decision(s) required to achieve goal:

Decide to select Master mode

Decide to Nav designate the IP (if required)

Decide to assign TDC

Decide to adjust Aircraft position / TD diamond

Decide that Aircraft/TD diamond is over the IP

Decide to designate IP

Decide to add offset data (if required)

Decide that the designation is accurate

Physical action(s) required to achieve goal:

Over fly designation.

Push the Master Mode switch (If required) Left hand
Look at the Master Mode light

Source of information required to achieve goal:

HUD TDC assignment location, IP location, Target Wypt information, distance and heading

Visual IP location

Radar TDC assignment location, IP location

AMIRS TDC assignment location, IP location

HSD Details of on-going or planned activities, TDC assignment location, IP location

Link 16/MIDS Specifics of the tactical situation, Details of on-going or planned activities

Aircraft Master Mode Light Aircraft Master mode selection

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The accuracy required when the pilot designates the IP is mostly in the procedure to achieve the goal The pilot has to follow specific steps to be successful.

The level of accuracy/precision required while the pilot is performing an overfly designation is 3 sec

The level of accuracy/ precision while the pilot is performing a sensor designation is 5 sec

Level of precision/accuracy required to perform the preceding action(s):

High

Level of precision/accuracy is based on actioning the proper switches at the required time, and while performing the designation, the action of designating a point has to be accurate

CF18 Air to Ground IFP Analysis Results

Move castle switch down (assign TDC to HSD) with right thumb
Look at HSD
Look out at IP
Move aircraft controls to fly over the IP
Depress TDC with left index
Look at HUD

Sensor designation·

Push the Master Mode switch (If required) Left hand
Look at the Master Mode light
Depress NAVDES push button on HSD
Move castle switch left or right (assign TDC to L/R DDI) with right thumb
Depress / Move TDC switch with left index
Depress the O/S pushbutton on the HSD
Look at HUD

For the overfly designation, the pilot requires to fly the aircraft accurately over the IP location, within 500 ft laterally. The pilot has to depress the TDC within 1 sec of overflying the specific IP location

For a sensor designation, the pilot has to position the cursers/ TD diamond within 3 mm of the desired position on the display.

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

HUD
HSD
Sensor displays

Factor(s) that influence the achievement of the goal:

Altitude
Speed
Threats
INS platform accuracy
Correction / Manoeuvering required to designate IP
Ease of pinpointing desired position
Environment
Switchology errors

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2 1(d) **Goal:** Manoeuvre to Weapons Delivery Parameters **Source Task:** 7 2 2 1(d)

Description:

Conduct attack type desired to get to optimal delivery parameters Level Attack, Curvilinear Attack, Pop Up Attack, Curvi Pop Attack, and Loft/Toss
The pull up is generally done by applying 3 G; smoothly and rapidly raising the nose to the desired climb angle. Adjust Power to achieve and maintain the desired IAS/TAS Anticipate the turn-in point and roll-in to the desired Dive angle by placing the Lift vector on the AOD (AIM Off Distance). Three G is normally used through the turn Anticipate Velocity vector approaching the AOD, and conduct an unloaded roll to wings level at the desired dive angle
Adjust Power to achieve and maintain the desired IAS/TAS Adjust dive angle to the desired delivery angle and cross check with Velocity Vector in the HUD Ensure stable platform is achieved prior to release. Aim weapons symbology at the desired Aim point

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures Applicable orders, regulations and plans

Mission requirements and objectives Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc) Details of on-going or planned activities

Aircraft position, heading, altitude, attitude, dive angle, speed, g

Attack specifics (Pull up point, Tip In altitude, Apex, Release Altitude, Target elevation, Aim Off distance, Dive angle)

Range to target, Azimuth to target

Target location, DMPI

Weather (Cloud ceiling), Winds

Decision(s) required to achieve goal:

Decide type of attack

Decide that the Point to start the manoeuvre has been reached

Decide to turn aircraft

Decide apply g to pull up to the desired climb angle

Decide to adjust Power (repeated)

Decide that the desired climb angle has been reached

Decide to look at the target

Decide to tip in

Decide to place lift vector on the AOD

Decide to pull g to manoeuvre to the AOD

Source of information required to achieve goal:

HUD Aircraft position, heading, altitude, attitude, dive angle, speed, g Range to target, Azimuth to target Target location, DMPI, winds

HSD Aircraft position, heading, speed Range to target, Azimuth to target, Target location, winds

Visual: Aircraft position, heading, altitude, attitude, dive angle, speed Range to target, Azimuth to target, Target location, DMPI, Weather (Cloud ceiling), Winds

Seat of the pants Aircraft attitude, speed, g, winds

Maps Attack specifics (Pull up point, Tip In altitude, Apex, Release Altitude, Target elevation, Aim Off distance, Dive angle), Target location, DMPI

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The pilot has to decide that the aircraft has reached the pull up point within 3 sec, turn the aircraft within 5 degrees of desired heading, apply required amount of g within 1 g, achieve desired climb and dive angle within 5 deg, maintain airspeed within 20 kts, Tip in altitude within 300ft, Place velocity vector on AOD within 1 deg, unload to 0 g within 0 5g

CF18 Air to Ground IFP Analysis Results

Decide that the AOD has been reached

Decide to roll Aircraft

Decide to correct AOD (if required)

Decide to adjust dive angle (if required)

Decide to stabilize parameters

Decide to aim the weapon symbology

Decide that the Aircraft has reached delivery parameters

Physical action(s) required to achieve goal:

Look at HUD (repeated)
Look out (repeated)
Move stick to roll Aircraft
Move throttles to adjust airspeed (repeated)
Pull back on stick to apply g
Move stick to roll Aircraft
Pull back on stick to apply g
Push on stick to unload to 0 g
Move stick to roll Aircraft
Pull back or push on stick to apply g to adjust dive angle
Move stick to make appropriate aiming corrections
Stabilize all movements prior to release

Level of precision/accuracy required to perform the preceding action(s):

High

The look at HUD/look out portions require 1-2 sec each time the task is performed (Medium)

The Aircraft controls have to be moved (or amount of pressure) accurately to achieve the desired results Level of precision in the movement of controls is directly linked to the level of precision required in reasoning.

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

HUD
Visual

Factor(s) that influence the achievement of the goal:

Aircraft configuration
Airspeed/ Energy prior to start of manoeuvre
Temperature
Threats
Target difficulty
Altitude
Desired dive angle (steep attack vs shallow attack)
Terrain
Weather
Winds
Aggressiveness
SA
Sun position (Could blank the HUD during delivery)
Fatigue (g)

CF18 Air to Ground IFP Analysis Results

Disorientation
Safety
Is the pilot really comfortable with steep dive angles (fear factor)
Ground rush (Visual effects)

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2 1(f) **Goal:** Conduct Element Split Attacks **Source Task:** 7 2 2.1(f)

Description:

While flying in tactical formation, at the pre-planned range from the target, wingmen perform an energy sustaining 90 degrees turn into lead Roll out on perpendicular track and maintain heading for the required time (5-20sec) At the appropriate time or on a visual ground reference, wingmen turn back towards the target and conduct their own attack, having achieved the required time separation from their leads Wingmen then cross check that they have the required separation as lead is over flying the target and adjust the run-in accordingly

Information required to achieve goal:

Aircraft operating procedures Tactics. Standard Operating procedures

Mission requirements and objectives Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc.) Details of on-going or planned activities
Type of weapons delivered

Aircraft position, heading, altitude, speed, g

Timing, navigation visual references

Own aircraft position in the formation and other members position, distance from other aircraft

Source of information required to achieve goal:

HUD Aircraft position, heading, altitude, speed, g, timing, distance from other aircraft

Visually: Aircraft position, heading, altitude, speed, navigation visual references, Own aircraft position in the formation and other members position, distance from other aircraft

Seat of the pants: aircraft g

Link 16/MIDS display: Aircraft position, Own aircraft position in the formation and other members position, distance from other aircraft

RDR display: Aircraft position, heading, Own aircraft position in the formation and other members position, distance from other aircraft

AMIRS navigation visual references, Own aircraft position in the formation and other members position, distance from other aircraft

HSD Aircraft position, heading, timing, Own aircraft position in the formation and other members position, distance from other aircraft

Auditory Weapon release tone from other aircraft

Decision(s) required to achieve goal:

Decide that aircraft has reached desired range/timing

Decide to start execution of the manoeuvre

Decide to roll out on desired heading to get spacing

Decide that proper delay timing has been achieved

Decide to turn back towards target

Decide to verify spacing from lead

Decide to adjust spacing if required

Decide that the proper spacing has been achieved

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The start of the manoeuvre does not have to be as precise as the execution of it The start is effective within 2 nm or 15sec

The execution has to be precise Turn to heading +/- 5 deg, timing delay +/- 2 sec, airspeed within 20 kts

The pilot has to analyse all inputs precisely to ensure that the desired separation is achieved The pilot will want to achieve the desired separation from his lead within 0 3 nm or within 2-3 sec

CF18 Air to Ground IFP Analysis Results

Physical action(s) required to achieve goal:

Look at displays

Look out

Move stick laterally to roll aircraft (repeated)

Pull back on stick for desired amount of g (repeated)

Roll out by moving stick (repeated)

Move throttles to maintain/sustain energy

Level of precision/accuracy required to perform the preceding action(s):

Medium

Proper separation will be achieved by a relatively precise and accurate execution of the physical actions required The level of precision does not have to be as high as the reasoning (or results). The precision in the results will be achieved by a series of less precise physical inputs to the controls

Higher precision required in the visual analysis of the distance from lead, 2 sec required every time the distance is assessed.

Type of feedback required to know that goal has been achieved:

Visually, Auditory, Cognitive

Source of feedback required to know that goal has been achieved:

HUD
Link 16/MIDS
AMIRS
RDR
Visually
Tone from radio

Factor(s) that influence the achievement of the goal:

Position in the formation
Terrain
Navigation features
Required separation (type of weapon)
Threats
Workload
Type of target (easy vs hard)
Eyesight / ability to maintain visual contact
Other formation members relative altitude in the run in
Situational Awareness
Level of precision achieved by other formation members (routing/airspeed)
Accuracy of INS/GPS platform
Amount of g pulled in turns
Target run in speed

CF18 Air to Ground IFP Analysis Results

IP Number 7.2 2 1(g) **Goal:** Validate Weapons Solution Display **Source Task:** 7 2 2 1(g)

Description:

Confirm visually on the HUD that all required delivery parameters have been attained for release Ensure that the proper weapon is selected and that the TDC is assigned to the appropriate display for delivery. Confirm visually on the HUD that the Master ARM is in the ARM position Visually confirm that the desired release symbology is displayed and is valid for release Confirm that the displayed aim point is on the DMPI (Desired Mean Point of Impact)

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures Weapons operating procedures

Mission requirements and objectives. Specifics of the tactical situation (e g. threat/friendly forces, weather, terrain, etc). Type of weapons delivered.

Aircraft designation, weapon designation, weapon delivery parameters

Weapons selected and armed

Aircraft speed, g , bank, dive angle, heading, velocity vector, altitude, azimuth, lateral g (rudder) inputs, Aircraft parameters stabilized, within delivery envelope

Source of information required to achieve goal:

HUD: Aircraft speed, g , bank, dive angle, heading, velocity vector, altitude, azimuth, rudder inputs, Aircraft parameters stabilized, Aircraft designation, Weapons selected and armed, within delivery envelope

AMIRS Aircraft designation

RDR: Aircraft designation

Maverick display· weapon designation, weapon delivery parameters, within delivery envelope

Seat of the pants lateral g (rudder) inputs, g, Aircraft parameters stabilized

Decision(s) required to achieve goal:

Decide to look at displays to validate weapon solution

Decide that aircraft is within delivery envelope

Decide that weapon is within delivery envelope

Decide that parameters are met and that the solution is valid

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Very high

The pilot is required to precisely and accurately analyse all delivery parameters in a very small time frame The level of accuracy in mental analysis, error detection and correction and validation is extremely demanding The task could be labeled as a 5-10 sec task because of the amount of information required to be analysed, but the pilot typically only has a few seconds to accomplish it, hence adding to the precision required

Physical action(s) required to achieve goal:

Look at displays

Level of precision/accuracy required to perform the preceding action(s):

High

Large amount of information in a small display, all important to effectively validate weapon solution

High precision required in aiming at the target

Type of feedback required to know that goal has been achieved:

Visually, Cognitive, Psychomotor, Auditory

Source of feedback required to know that goal has been achieved:

HUD
Visually
Seat of the pants

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Ability to assimilate a large amount of information rapidly
Stress level / ability to think/ analyse under stress
Amount of time to perform validation
Altitude / threat level
Amount of correction required to validate solution
Dive angle / speed
Background
Eyesight
Type of weapon
Doctrine (ex.. is the aircraft previously armed or can you only arm weapon when solution verified)
Amount of g at validation
Fatigue form previous g
Disorientation / unfamiliar attitude at validation

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2.1(h) **Goal:** Deliver GP Weapons(Bombs/Rx/Cluster/Gx) **Source Task:** 7 2 2 1(h)

Description:

Depress and hold the weapons release button (Pickle button) on the stick. Confirm that the weapons are being released Once all weapons have been released, release Pickle button Confirm weapons release on the SMS page on the DDI

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures. Weapons operating procedures

Type of weapons released, weather conditions, visibility, winds, sun, terrain, target type

Weapon release command received by aircraft

Desired quantity and type of weapons released

Source of information required to achieve goal:

HUD. Type of weapons released, Weapon release command received by aircraft, Desired quantity and type of weapons released

SMS page: Desired quantity and type of weapons released

Visually weather conditions, visibility, winds, sun, terrain, target type

Decision(s) required to achieve goal:

Decide to release weapons

Decide that weapons are being released safely and effectively

Decide to stop releasing weapons

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The timing to start the release of weapons has to be accurate to within 1 sec (sometimes less) of desired delivery point

Physical action(s) required to achieve goal:

Depress and hold the weapons release button (Pickle button) on the stick

Look at HUD to confirm visually that the weapons are being released

Release Pickle button

Look at HUD/SMS display to confirm weapons released on the SMS page on the DDI.

Level of precision/accuracy required to perform the preceding action(s):

High

The physical action of depressing the weapons release button requires precision in timing to within 0 5 sec.

Some precision also required in the duration of execution of the task -0sec from the end of delivery to + 5sec (If the pickle button is released before required time, not all weapons will fall)

Type of feedback required to know that goal has been achieved:

Visually, Auditory, Cognitive, Psychomotor

Source of feedback required to know that goal has been achieved:

HUD
SMS display
Visually

Factor(s) that influence the achievement of the goal:

Number (quantity/multiple/interval) of weapons released
Type of weapon released
Size of weapon released
Delivery window (time)
Environmental conditions

CF18 Air to Ground IFP Analysis Results

Coordination / response (Brain signal to deliver weapon vs thumb action)
Terrain avoidance, anticipation of safe escape manoeuvre
Threats
Ego / state of mind (fighter pilots wanting/anticipating success vs actual actions)

CF18 Air to Ground IFP Analysis Results

IP Number 7 2.2 1(i) **Goal:** Conduct Safe Escape Manoeuvre **Source Task:** 7 2 2.1(i)

Description:

At the appropriate recovery altitude or when pull-up cue / breakaway X is displayed in the HUD, the pilot must achieve a 4-G pull-up manoeuvre within 1 5 seconds and hold the 4-G throughout the pullout until desired climb angle is achieved to meet the clearance criteria Adjust throttles to achieved and maintain desired recovery airspeed. Cross check Baro or Radar altitude during recovery to ensure minimum altitude is not broken Increase G if required

Information required to achieve goal:

Aircraft operating procedures. Tactics, Standard Operating procedures Recovery/pull up symbology.

Minimum recovery altitude, terrain, slope, weather, visibility

Pull-up Cue / breakaway X

Aircraft altitude, attitude, speed, bank , dive angle and g

Aircraft configuration

Decision(s) required to achieve goal:

Decide to start dive recovery / safe escape

Decide to roll aircraft wings level

Decide to apply desired amount of g

Decide to adjust power

Decide to increase g (if required)

Decide that aircraft has reached safe altitude/ attitude

Physical action(s) required to achieve goal:

Look at the HUD for recovery cues (repeated)

Roll out of any bank by moving stick sideways

Pull back on stick to apply required amount of g

Adjust throttles as required

Release back pressure (g) on stick once safe altitude has been reached

Type of feedback required to know that goal has been achieved:

Visual, cognitive, psychomotor, (Lack of auditory signal)

Source of information required to achieve goal:

HUD: Aircraft altitude, airspeed, attitude, speed, bank , dive angle and g Pull-up Cue / breakaway X

Visual cues terrain, slope, weather, visibility Aircraft altitude, airspeed, attitude, speed, bank , dive angle, and g. Aircraft configuration

Seat of the pants: Aircraft airspeed, speed, and g, Aircraft configuration

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The pilot has to quickly switch from delivering weapons to the safe escape manoeuvre Sometimes the cues to start the recovery happen before all weapons have been released, and the pilot has to analyse this situation with high level of accuracy and then start recovery while it is still safe to do so

Start dive recovery within 1 sec / 100ft of required time / altitude, Wings level within 10 deg, g applied within 1 g, onset of g within 0.5 sec (4 g in 1.5 sec), airspeed within 30 kts, climb angle within 5 deg

Level of precision/accuracy required to perform the preceding action(s):

High

Manoeuvre is calculated on starting at the appropriate time (altitude), pulling precisely the amount of g calculated until safe altitude has been reached

The precision in the physical action is directly related to the precision in the reasoning (results)

Source of feedback required to know that goal has been achieved:

HUD
Visually
Seat of the pants (g)

CF18 Air to Ground IFP Analysis Results

Factor(s) that influence the achievement of the goal:

Excessive Airspeed
Amount of g pulled
Threats
SA
Aircraft configuration
Throttle setting prior to recovery (Spool up time)
Bank angle (Prior to and during recovery)
Temperature
Exposure (Conflict between safe escape and exposure to threats)

CF18 Air to Ground IFP Analysis Results

IP Number 7.2 2 1(j) **Goal:** Conduct Frag Avoidance Manoeuvre **Source Task:** 7 2 2 1(j)

Description:

Conduct turning safe escape manoeuvre, climbing safe escape manoeuvre, level straight through safe escape manoeuvre or recovery above weapon frag altitude
At the appropriate frag avoidance recovery altitude or distance, the pilot must achieve the desired G pull-up manoeuvre within 1 5 seconds and hold the G throughout the pullout until desired climb angle or heading away from target is achieved to meet the Frag clearance criteria Adjust throttles to achieved and maintain desired airspeed. Cross check Baro, Radar altitude and range to target during avoidance manoeuvre to ensure minimum altitude or distance is not bracken Increase G if required

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures. Frag avoidance manoeuvres procedures

Type of weapon released, Frag envelope

Weather conditions, visibility, winds, sun, terrain, slope, target type

Minimum frag avoidance altitude and or range

Aircraft altitude, attitude, speed, bank , dive angle and g

Distance from target

Aircraft configuration.

Source of information required to achieve goal:

HUD· Aircraft altitude, airspeed, attitude, speed, bank , dive angle and g, Distance from target

Visual · Weather conditions, visibility, winds, sun, terrain, slope, target type Distance from target Aircraft configuration

Seat of the pants Aircraft speed and g Aircraft configuration

Decision(s) required to achieve goal:

Decide type of manoeuvre to be used

Decide to start Frag Avoidance Manoeuvre

Decide to manoeuvre aircraft / throttles

Decide that aircraft has reached safe distance from frag

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The pilot has to quickly switch from delivering weapons to Frag Avoidance Sometimes the cues to start the recovery happen before all weapons have been released, and the pilot has to analyse this situation with high level of accuracy and then start manoeuvre while it is still safe to do so

Start the manoeuvre within 2 sec/ 0 2 nm from the desire time / distance from the target Roll within 10 deg, g applied within 1 g, onset of g within 0 5 sec
(X g in 1 5 sec), airspeed within 30 kts, climb angle within 5 deg

Physical action(s) required to achieve goal:

Look at the HUD for frag avoidance cues (repeated)

Manoeuvre aircraft with stick in roll and pitch to execute desired manoeuvre

Pull back on stick to apply required amount of g

Adjust throttles as required

Level of precision/accuracy required to perform the preceding action(s):

High

Manoeuvre is calculated on starting at the appropriate distance (altitude) from the weapons / target, manoeuvering aircraft accurately through the desired profile, and pulling precisely the amount of g calculated or required

The precision in the physical action is directly related to the precision in the reasoning (results)

CF18 Air to Ground IFP Analysis Results

Release back pressure (g) on stick once safe distance form Frag has been reached

Type of feedback required to know that goal has been achieved:

Visual, Cognitive, Psychomotor

Source of feedback required to know that goal has been achieved:

HUD
Visually
Seat of the pants (g)

Factor(s) that influence the achievement of the goal:

Excessive Airspeed
Amount of g pulled
Threats
SA
Aircraft configuration
Throttle setting prior to manoeuvre (Spool up time)
Bank angle (Prior to and during recovery)
Temperature
Exposure (Conflict between frag recovery and exposure to threats)
Type of weapon
Risk level

CF18 Air to Ground IFP Analysis Results

IP Number 7.2 2 1(k) **Goal:** Conduct BDA **Source Task:** 7 2 2 1(k)

Description:

After ensuring that Aircraft is safely recovered from delivery, if desired the target BDA can be conducted by assessing Bomb impact point and damage resulting from hit Visually assess the AMIRS display

Information required to achieve goal:

Technique for assessment of target battle damage on IR display Weapons effects

Target type and size, Weapons type, Weapons impact angle, weather, distance, AMIRS magnification.

View of the Weapons effects on target post strike

Source of information required to achieve goal:

AMIRS View of the Weapons effects on target post strike Target type and size, Weapons impact angle, AMIRS magnification.

Visually. View of the Weapons effects on target post strike, Target type and size, Weapons type, Weapons impact angle, weather, distance

Decision(s) required to achieve goal:

Decide to conduct BDA

Decide to look at displays / visually at the target

Decide to assess BDA

Decide that the BDA has been assessed

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Based on pilots interpretation of the Battle damage This task requires between 1-3sec of attending

Physical action(s) required to achieve goal:

Look at the displays

Look out

Level of precision/accuracy required to perform the preceding action(s):

Medium

Visual assessment of a display / outside world

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

AMIRS
Visually

Factor(s) that influence the achievement of the goal:

Weapons effect
% of destruction
Target visibility post strike (smoke, sun angle)
Threats
Amount of time available
Line of sight to target post strike

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2 1(n) **Goal:** Search for Initial Point **Source Task:** 7 2 2 1(n)

Description:

Anticipate what the IP and surrounding area look like by reviewing the attack map visually or mentally When reviewing the map, recognize how your run-in ground track will bring you into and over the IP Look out and search for large features that help you to identify smaller features that lead your eyes to the IP

Information required to achieve goal:

Visual search pattern technique. Pattern recognition, keys features to find ground patterns visually.

Specific Initial Point surrounding features (e g terrain, large features surrounding IP, smaller unique IP features, weather, etc)

Aircraft position, altitude, speed, heading, ground track

Aircraft IP designation

Distance from IP, run in direction, IP elevation, anticipated distance from IP where line of sight is possible

Source of information required to achieve goal:

HUD Aircraft position, altitude, speed, heading, ground track, Distance from IP, Aircraft IP designation

HSD: Aircraft position, ground track, distance from IP, run in direction, Aircraft IP designation

AMIRS Specific IP surrounding features (e g terrain, large features surrounding IP, smaller unique IP features, weather, etc) Aircraft IP designation

Visually Specific IP surrounding features (e g terrain, large features surrounding IP, smaller unique IP features, weather, etc)

Decision(s) required to achieve goal:

Decide to start searching for the IP

Decide to look at IP designation

Decide to look at displays

Decide to look out to visually search for IP

Decide that the IP has been found

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Good mental picture of the expected IP and surroundings is required to search and find IP Typically, the pilot will search within 20 deg of the expected position and within 2-3 nm in distance

Physical action(s) required to achieve goal:

Look at displays

Look at IP Maps

Search for IP visually

Level of precision/accuracy required to perform the preceding action(s):

Medium

The precision accuracy required while looking at the displays will required between 0 5-2 sec

The visual search pattern and the method used to find IP require some level of precision to be effective Usually the feature chosen as an IP will be as obvious as possible The level of precision in the visual search is directly linked to the reasoning precision

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visually
AMIRS
HUD

Factor(s) that influence the achievement of the goal:

IP size, shape

CF18 Air to Ground IFP Analysis Results

IP surroundings
Aircraft altitude and speed
Eyesight
Light condition (DAY/NIGHT/DUSK)
Crosscheck effectiveness (can the pilot effectively split his attention between Flying the aircraft and searching the IP)
Threats
Time available for task

CF18 Air to Ground IFP Analysis Results

IP Number 7.2.2.1(o) **Goal:** Search for Target **Source Task:** 7.2.2.1(o)

Description:

Anticipate what the target surrounding area look like by reviewing the target photos, Maps or data linked imagery visually or mentally. When reviewing the target, recognize how your run-in ground track will bring you into and over the target

Look out and search for large features that help you to identify smaller features that lead your eyes to the Target Find DMPI

Information required to achieve goal:

Visual search pattern technique Pattern recognition, key features to find ground patterns visually

Specific Target surrounding features (e.g. terrain, large features surrounding Target, smaller unique target features, weather, etc.)

Aircraft position, altitude, speed, heading, ground track

Aircraft target designation

Distance from target, attack run in direction, target elevation, anticipated distance from the target where line of sight is possible

Source of information required to achieve goal:

HUD Aircraft position, altitude, speed, heading, ground track, Distance from target, Aircraft target designation

HSD Aircraft position, ground track, distance from target, attack run in direction, Aircraft target designation

AMIRS Specific Target surrounding features (e g terrain, large features surrounding Target, smaller unique target features, weather, etc.) Aircraft target designation

Visually Specific Target surrounding features (e g terrain, large features surrounding Target, smaller unique target features, weather, etc)

Decision(s) required to achieve goal:

Decide to look at target designation

Decide to look at displays

Decide to search for target visually

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

Precise mental picture of the expected target and surroundings is required to search and find target Typically, the pilot will search within 10 deg of the expected position and within 1-2 nm in distance

Physical action(s) required to achieve goal:

Look at displays
Look at target photos, Maps or data linked imagery
Search for target visually

Level of precision/accuracy required to perform the preceding action(s):

High

The search pattern and the method used to find target require high level of precision to be effective (very challenging task) This task can demand the equivalent of 2-5 sec when sometimes only 1-3 sec are available

Type of feedback required to know that goal has been achieved:

Visual, cognitive

Source of feedback required to know that goal has been achieved:

Visually
AMIRS
HUD

Factor(s) that influence the achievement of the goal:

Target type, size, shape, camouflage
Target surroundings
Aircraft altitude and speed

CF18 Air to Ground IFP Analysis Results

Eyesight
Light condition (DAY/NIGHT/DUSK)
Crosscheck effectiveness (can the pilot effectively split his attention between Flying the aircraft and searching the target)
Threats

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2.2(b) **Goal:** Designate Target Position **Source Task:** 7 2 2 2(b)

Description:

First NAV designate the Target position (or Offset aim point) With the TDC assigned to the desired display (Radar or the AMIRS), the designation is then adjusted by moving the TD diamond or the NAV stabilized cursor designation When satisfied that the designation is accurately on the Target (or Offset point) add O/S if required (Pre-programmed) by depressing the appropriate push button on the HSD Confirm that the Target Wypt, distance and heading are displayed in the HUD and that they are accurate

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures Designation procedures Sensor displays and symbology interpretation

Mission requirements and objectives. Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc.) Details of on-going or planned activities

General target Area features

Specific target features

Aircraft Master mode selection, TDC assignment location,

Target / Offset location

Target Wypt information, distance and heading

Source of information required to achieve goal:

HUD TDC assignment location, Target/Offset location, Target Wypt information, distance and heading

Visual Target/Offset location, Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc), General target Area features Specific target features

Radar TDC assignment location, Target/Offset location, General target Area features Specific target features

AMIRS TDC assignment location, Target/Offset location, General target Area features Specific target features

HSD Details of on-going or planned activities, TDC assignment location, Target/Offset location

Link 16/MIDS Specifics of the tactical situation, Details of on-going or planned activities

Aircraft Master Mode Light Aircraft Master mode selection

Decision(s) required to achieve goal:

Decide to select Master mode

Decide to Nav designate the Target / Offset

Decide to assign TDC

Decide to adjust TD designation

Decide that TD diamond is over the Target / Offset

Decide to add offset data (if required)

Decide that the designation is accurate

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The accuracy required when the pilot designates the Target is mostly in the procedure to achieve the goal The pilot has to follow specific steps to be successful

The level of accuracy/ precision while the pilot is designating the target is 5 sec

Physical action(s) required to achieve goal:

Push the Master Mode switch (If required) with Left hand
Look at the Master Mode light
Depress NAVDES push button on HSD
Move castle switch left or right (assign TDC to L/R DDI) with right thumb
Depress / Move TDC switch with left index
Depress the O/S pushbutton on the HSD (if required)
Look at HUD

Level of precision/accuracy required to perform the preceding action(s):

High

Level of precision/accuracy is based on actioning the proper switches at the required time, and while performing the designation, the action of designating a point has to be accurate

For a sensor designation, the pilot has to position the cursers/ TD diamond within 0 25 cm of the desired position on the display

CF18 Air to Ground IFP Analysis Results

Type of feedback required to know that goal has been achieved:	**Source of feedback required to know that goal has been achieved:**
Visual, Cognitive	RDR display AMIRS display HUD

Factor(s) that influence the achievement of the goal:

Altitude
Speed
Threats
INS platform accuracy
Correction required to accurately designate Target / offset
Accuracy of offset data
Environment and effects on sensors
Switchology errors

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2 2(c)   **Goal:** Identify Target Area with Aircraft Sensors   **Source Task:** 7 2 2.2(c)

Description:

Anticipate what the target surrounding area look like by reviewing the target photos, Maps or data linked imagery visually or mentally When reviewing the target, recognize how your run-in ground track will bring you into and over the target Visually look at the displayed target Area picture and search for large features that help you to identify smaller features Identify target Area

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures. Sensor displays and symbology interpretation

Specific target area features (e.g. terrain, large features surrounding target, weather, etc)

Distance from target, attack run in direction, size of sensor footprint, anticipated target area features and layout within that footprint

Target designation symbol (TD diamond)

Source of information required to achieve goal:

Target photos, Maps or data linked imagery Specific target area features (e g terrain, large features surrounding target, weather, etc.) Attack run in direction, size of sensor footprint, anticipated target area features and layout within that footprint

AMIRS. Specific target area features (e g terrain, large features surrounding target, weather, etc) Distance from target, attack run in direction, size of sensor footprint, target area features and layout within that footprint. Target designation symbol.

RDR Specific target area features (e g terrain, large features surrounding target) Distance from target, attack run in direction, size of sensor footprint, target area features and layout within that footprint Target designation symbol.

Decision(s) required to achieve goal:

Decide to identify Target Area with Aircraft Sensors

Decide to review the target photos, Maps or data linked imagery

Decide which sensor to use to identify target area

Decide to optimize sensor image

Decide to look at specific target area features on the displays

Decide that the target area has been identified

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

From the information provided by intelligence, the pilot has to visualise and memorize the target area He then has to precisely associate the features presented to him to his memorized image of the target, and then identify the target area with high level of confidence (hence high precision) Typically the pilot has to identify 2-3 distinct features in the target Area, a task that demands between 1-3 sec

Physical action(s) required to achieve goal:

Look at the target area photos, Maps or data linked imagery

Move castle switch towards selected display

Move/Depress TDC to position cursers to adjust displayed sensor image

Look at displays

Level of precision/accuracy required to perform the preceding action(s):

Medium

The pilot has to fairly accurately look at the information displayed The level of precision/ accuracy is directly linked to the reasoning

Type of feedback required to know that goal has been achieved:

Visual, cognitive

Source of feedback required to know that goal has been achieved:

The main source of feedback is the belief that you have identified the target area (Cognitive)

This is back up by other sensors information, target coordinates, visual confirmation

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Target area significant features
Sensor representation of the significant features
Familiarity with type of sensor display image
Time of day
Reflectivity
Contrast with surroundings
Range / Magnification
Environmental factors and effects on sensor

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2 2(e) **Goal:** Identify Target Using Map/Imagery/Onboard Sensors/LINK 16 **Source Task:** 7 2 2 2(e)

Description:

Anticipate what the target looks like by reviewing the target photos, Maps or data linked imagery visually or mentally When reviewing the target, recognize what the target image should look like on the displays

Adjust Sensors information displayed to optimize target resolution and recognition features Visually look at the target picture displayed on the Sensors tactical displays and search for large features that help you to identify smaller features Identify target

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures. Anticipation of target representation on display for conditions of the day Interpretation of Map/Imagery/Onboard Sensors and symbology/LINK 16.

Specific target features (e g terrain, large target features, smaller unique target features, weather, etc.)

Target IR picture Surrounding IR picture

Target Radar Picture Surrounding Radar picture

Data link Imagery of target

Distance from target, attack run in direction, anticipated target features visible from attack direction and target layout

Target designation symbol (TD diamond)

Decision(s) required to achieve goal:

Decide to identify Target Using Map/Imagery/Onboard Sensors/LINK 16

Decide to review the target photos, Maps or data linked imagery

Decide which sensor to use to identify target

Decide to optimize sensor image

Decide to look at specific target features on the displays

Decide that the target has been identified.

Physical action(s) required to achieve goal:

Look at the target photos, Maps or data linked imagery

Move castle switch towards selected display

Move/Depress TDC to position cursers to adjust displayed sensor image

Look at displays

Source of information required to achieve goal:

Target photos, Maps or data linked imagery Specific target features (e g terrain, large target features, smaller unique target features, etc.) Attack run in direction, anticipated target features visible from attack direction and target layout.

AMIRS Specific target features (e g terrain, large target features, smaller unique target features, weather, etc). Target IR picture Surrounding IR picture

RDR: Specific target features (e g terrain, large target features, smaller unique target features, weather, etc) Target Radar Picture Surrounding Radar picture

Link 16/MIDS Data link Imagery of target. Target Radar Picture Surrounding Radar picture

HUD/HSD Distance from target, attack run in direction Target designation symbol (TD diamond)

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

From the information provided by intelligence, the pilot has to visualise and memorize the target layout He then has to precisely associate the features presented to him to his memorized image of the target, and then identify the target with high level of confidence (hence high precision) Typically the pilot has to identify 3-4 distinct features in the target, a task that demands between 2-5 sec

Level of precision/accuracy required to perform the preceding action(s):

Medium

The pilot has to fairly accurately look at the information displayed The level of precision/ accuracy is directly linked to the reasoning

CF18 Air to Ground IFP Analysis Results

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Factor(s) that influence the achievement of the goal:

Target significant features
Sensor representation of the significant features
Familiarity with type of sensor display image
Time of day
Reflectivity
Contrast with surroundings
Range / Magnification
Environmental factors and effects on sensor
Target size / type

Source of feedback required to know that goal has been achieved:

The main source of feedback is the belief that you have identified the target (Cognitive)

This is back up by other sensors information, target coordinates, visual confirmation

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2 2(g) **Goal:** Deliver PGM (LGB/MAV/Adv PGM) **Source Task:** 7 2 2 2(g)

Description:

Depress and hold the weapons release button (Pickle button) on the stick Confirm that the PGM weapons are being released Once all weapons have been released, release Pickle button Confirm weapons release on the SMS page on the DDI

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures Weapons operating procedures

Type of weapon released, weather conditions, visibility, winds, sun, terrain, target type

Weapon release command received by aircraft

Transition to Laser countdown

Desired quantity and type of weapons released

Decision(s) required to achieve goal:

Decide to deliver PGM

Decide that weapons are being released safely and effectively

Decide to stop releasing weapons

Physical action(s) required to achieve goal:

Look at HUD/AMIRS/Mav Display for release cue

Depress and hold the weapons release button (Pickle button) on the stick

Look at HUD to confirm that the weapons are being released

Look at AMIRS to confirm that the weapons are being released

Look at MAV display to confirm that the weapons are being released

Release Pickle button

Look at HUD/SMS display to confirm weapons released on the SMS page on the DDI

Type of feedback required to know that goal has been achieved:

Visual, Cognitive, Auditory, Psychomotor

Source of information required to achieve goal:

HUD Type of weapons released, Weapon release command received by aircraft, Desired quantity and type of weapons released, winds, target type

SMS page Desired quantity and type of weapons released

AMIRS Weather conditions, visibility, sun, terrain, target type. Transition to Laser countdown

Mav display Weapon release command received by aircraft

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The timing to start the release of weapons has to be accurate to within 1 sec (sometimes less) of desired delivery point

Level of precision/accuracy required to perform the preceding action(s):

High

The physical action of depressing the weapons release button requires precision in timing to within 1sec (Precision not as critical at release as GP bombs since weapon will guide to the target)

Some precision also required in the duration of execution of the task -0sec from the end of delivery to + 5sec (If the pickle button is released before required duration, not all weapons will fall)

Source of feedback required to know that goal has been achieved:

HUD
AMIRS
Mav Display

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SMS display
Visually

Factor(s) that influence the achievement of the goal:

Number (quantity/multiple/interval) of weapons released
Type of weapon released
Size of weapon released
Delivery window (time)
Environmental conditions
Coordination / response (Brain signal to deliver weapon vs thumb action)
Altitude
Terrain avoidance
Threats
Ego / state of mind (fighter pilots wanting/anticipating success vs actual actions)

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2 2(j) **Goal:** Update Target Designation

Source Task: 7 2 2 2(j)

Description:

Adjust and update target designation on the desired aim point by moving the TDC If required, turn the aircraft to the right to ensure constant field of view to the target

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures. Designation procedures. Sensor displays and symbology interpretation

Specific target area features (e g terrain, large features surrounding target, weather, etc.), type of attack, type of weapon delivered.

Specific Target features

Aircraft Altitude, heading, speed, bank angle, flight path

Aircraft Master mode selection, TDC assignment location

Source of information required to achieve goal:

HUD. TDC assignment location, type of attack, type of weapon delivered Aircraft Altitude, heading, speed, bank angle, flight path

Visual Specific target area features (e.g terrain, large features surrounding target, weather, etc), Specific Target features Aircraft Altitude, heading, bank angle, flight path

Radar. TDC assignment location, Specific target area features (e g terrain, large features surrounding target, etc) Specific Target features

AMIRS· TDC assignment location, Specific target area features (e g terrain, large features surrounding target, weather, etc) Specific Target features

Aircraft Master Mode Light Aircraft Master mode selection

Decision(s) required to achieve goal:

Decide to update target designation

Decide to assign TDC (if required)

Decide to look at display

Decide to adjust designation position

Decide to manoeuvre aircraft (if required)

Decide that the target designation symbology is on the desired target aim point.

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The accuracy required when the pilot updates the target designation is mostly in the procedure to achieve the goal The pilot has to follow specific steps to be successful

The level of accuracy/ precision while the pilot is updating the target designation is 1-2 sec

Physical action(s) required to achieve goal:

Push the Master Mode switch (If required) Left hand
Look at the Master Mode light
Move castle switch left or right (assign TDC to L/R DDI) with right thumb
Depress / Move TDC switch with left index
Move aircraft controls to manoeuvre aircraft
Look at Display

Level of precision/accuracy required to perform the preceding action(s):

High

Level of precision/accuracy is based on actioning the proper switches at the required time, and while updating the designation, the action of moving the TD diamond/cursers has to be accurate

In order to update the target designation, the pilot has to re-position/maintain the cursers/ TD diamond within 0.25 mm of the desired position on the display

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

AMIRS
RDR
HUD

CF18 Air to Ground IFP Analysis Results

Factor(s) that influence the achievement of the goal:

Altitude
Speed
Threats
INS platform accuracy (Drift)
Correction required to accurately designate Target
Environment and effects on sensors
Podium effect
Range

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 2 2(m) **Goal:** Conduct Coordinated Attacks with Other Aircraft/Elements/Sections **Source Task:** 7 2 2 1(l)

Description:

Maintain spacing by confirming that other Aircraft, Elements or Sections are conducting target attack as planned Ensure that own attack is conducted within the allotted time window. Adjust spacing or routing to target to maintain required spacing from other Aircraft, Elements or Sections ahead Maintain lookout to ensure all collision potentials are avoided, and to provide mutual support Change flight path as necessary.

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures Mass attack coordination.

Number and type of aircraft involved Specific target area features (e g terrain, large features surrounding target, weather, etc.), type of attack, type of weapon delivered.

Own aircraft position, altitude, airspeed, heading

Other aircraft position, altitude, heading

Routing to target, threats in the target area,

Time of day

Predicted timing over target, required groundspeed

Source of information required to achieve goal:

Visual Number and type of aircraft involved, Specific target area features (e g. terrain, large features surrounding target, weather, etc.) Own aircraft position, altitude, airspeed, heading Other aircraft position, altitude, heading Routing to target, threats in the target area, Predicted timing over target, required groundspeed

Link 16/MIDS· Number and type of aircraft involved, Own aircraft position, Other aircraft position Routing to target, threats in the target area,

RDR Number and type of aircraft involved, Specific target area features (e g terrain, large features surrounding target, etc), Other aircraft position, altitude, heading. Threats in the target area,

HUD type of attack, type of weapon delivered Own aircraft position, altitude, airspeed, heading. Other aircraft position, altitude, heading Routing to target, threats in the target area Time of day, required groundspeed

HSD Own aircraft position, airspeed, heading Other aircraft position, heading Routing to target, threats in the target area. Time of day, Predicted timing over target, required groundspeed.

AMIRS Number and type of aircraft involved, Specific target area features (e.g terrain, large features surrounding target, weather, etc) Other aircraft position, altitude, heading Threats in the target area,

Decision(s) required to achieve goal:

Decide to Conduct Coordinated Attacks with Other Aircraft/Elements/Sections

Decide to fly planned attack to the target

Decide to look out/ at displays

Decide to analyse other aircraft position / flow to the target

Decide to analyse own aircraft position / flow to the target

Decide to Identify potential conflicts

Decide to adjust attack to the target (if required)

Decide that the attack is coordinated with others to ensure safety and success

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The pilot will be required to be over the target in the planned TOT window Depending on the complexity of the attack and the TOT compression, that window may be hard time, and sometimes some flexibility may be available to a MAX of ~10 sec outside of the TOT window

The aim is still to be over the target at the planned TOT (within that TOT window) +/- 10 sec

All potential conflicts have to be resolved 100%

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Physical action(s) required to achieve goal:

Look out
Look at displays
Move aircraft controls to adjust flight path
Move throttles to adjust airspeed

Level of precision/accuracy required to perform the preceding action(s):

High

The level of precision required is directly linked to the reasoning

Airspeed within 20kts
Altitude within 100 ft
Heading within 10 deg

Type of feedback required to know that goal has been achieved:

Visual, Cognitive, Auditory

Source of feedback required to know that goal has been achieved:

Link 16/MIDS
RDR
AMIRS
Visual
HSD

Factor(s) that influence the achievement of the goal:

Number of aircraft in the attack
Environment
Threats
Ability to fly planned attack
Delays enroute (prior to the attack)
Type of target
Time compression
Frag avoidance
Egress routing

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 3 1(a) **Goal:** Establish Radar Contact with Other Formation Members **Source Task:** 7.1.1 2(a)

Description:

Adjust and/or confirm Radar parameters to ensure searching the desired airspace Observe Radar picture being built on the Radar display Confirm position of other mission elements by moving radar cursors over their displayed position and reading the displayed Bearing(or Bull eye)/Range/Altitude

Information required to achieve goal:

Aircraft operating procedures Tactics. Standard Operating procedures Radar operation

Mission requirements and objectives. Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc.)

Formation members position (bearing/range) , altitude,

Position of Bull eye, Formation member position wrt Bull eye

IFF interrogation reply

Source of information required to achieve goal:

RDR Formation members position (bearing/range) , altitude, Position of Bull eye, Formation member position wrt Buil eye, IFF interrogation reply

HUD Formation members position (bearing/range) , altitude, IFF interrogation reply

Visual Specifics of the tactical situation (e g threat/friendly forces, terrain)

Link 16/MIDS· Specifics of the tactical situation (e g threat/friendly forces), IFF interrogation reply

Decision(s) required to achieve goal:

Decide to establish RDR contact with other formation members

Decide find out formation members position

Decide to adjust RDR parameters to cover desired position

Decide to correlate contacts to bull eye position and other sensors

Decide that RDR contact has been established

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The precision required when establishing the position of the other formation member is within 10 degrees in bearing/azimuth and 2 nm in range

The Radar parameters must be chosen to cover the expected position of the contact, both in azimuth and in range

The correlation to other sensors and expected position is to the precision of 10 degrees in bearing/azimuth and 2 nm in range.

Physical action(s) required to achieve goal:

Look at displays

Look out

Move and press down on the TDC with left index to adjust parameters on display

Look at RDR display

Move TDC to move cursers to desired position on RDR display

Level of precision/accuracy required to perform the preceding action(s):

High

The level of precision while looking at the displays/look out is 1-2 sec

The level of precision/accuracy to adjust parameter on the display is to move the index to place the cursers within 1 cm of desired position on the display

2-5 sec precision/accuracy required to analyse the Radar display

The level of precision/accuracy to place the cursers at the desired position on the Radar display to find out contact position requires to move the index to place the cursers within 0 5 cm of desired position on the display

CF18 Air to Ground IFP Analysis Results

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

RDR display

Link 16/MIDS
HUD
Visual
AMIRS

Factor(s) that influence the achievement of the goal:

Range
Number of contacts on the RDR display
Formation member aspect and radar return
Altitude
Closure
Azimuth (within RDR coverage, as a minimum)
RDR parameters chosen for search (Azimuth and elevation)

CF18 Air to Ground IFP Analysis Results

IP Number 7 2.3 1(d) **Goal:** Establish Visual Contact with Other Formation Members **Source Task:** 7.1 1.2(f)

Description:

From SA built with Aircraft sensors and LINK 16/MIDS, look in the estimated bearing and range of the mission elements Start a visual search pattern focusing on the estimated distance of the contacts. Find mission elements visually

Information required to achieve goal:

Visual search pattern technique.

Mission requirements and objectives. Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc.)

Formation members range/azimuth , altitude

Source of information required to achieve goal:

HUD Formation members range/azimuth , altitude

RDR Formation members range/azimuth , altitude

Link 16/MIDS Specifics of the tactical situation (threat/friendly forces), Formation members range/azimuth , altitude

AMIRS Formation members range/azimuth ,

Visual· weather, terrain, Formation members range/azimuth , altitude

Decision(s) required to achieve goal:

Decide to find Formation members visually

Decide to find formation members position on Displays

Decide to look out

Decide to establish search pattern

Decide that the formation members have been acquired

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Accuracy/precision while finding formation members on the Displays depends on the number of contacts presented at one time. For 1 formation member 0 5 sec, for 2- 4 formation members 1-2 sec, if the display is more complex then 2-3 sec

Correlation between information on displays and look out has to be within 10 deg in azimuth and 5 deg in elevation Focus distance within 5 nm The visual search pattern should cover enough area while remaining concentrated around expected position (within 20 deg and 5 nm) Once the formation member has been found, correlation to the memorized position and/or with sensors should be within 1 nm and 20 deg in azimuth (depending on the number of aircraft in the immediate area).

Physical action(s) required to achieve goal:

Look at displays

Look out

Level of precision/accuracy required to perform the preceding action(s):

Medium

The precision/accuracy required is directly linked to the precision required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

HUD
RDR
Link 16/ MIDS
AMIRS
Visual

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Eyesight
Visibility
Formation Members position (at expected position?)
Complexity of attack
Terrain
Distance from contact
Bearing to contact
Threats
Speed
Background

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 3 1(e) **Goal:** Establish AMIRS Contact with Other Formation Members **Source Task:** 7 1.1 2(g)

Description:

Adjust and/or confirm AMIRS parameters to ensure searching the desired airspace Observe IR picture being built on the AMIRS display Confirm position of other mission elements by moving AMIRS cursors over their displayed position and reading the displayed bearing and elevation.

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures AMIRS operation.

Mission requirements and objectives. Specifics of the tactical situation (e g. threat/friendly forces, weather, terrain, etc)

Formation members range/range) , altitude,

Position of Bull eye, Formation member position wrt Bull eye

IFF interrogation reply

Source of information required to achieve goal:

AMIRS Formation members range/range) , Position of Bull eye, Formation member position wrt Bull eye

RDR Formation members range/range) , altitude, Position of Bull eye, Formation member position wrt Bull eye, IFF interrogation reply

HUD Formation members range/range) , altitude, IFF interrogation reply

Visual Specifics of the tactical situation (e g threat/friendly forces, terrain)

Link 16/MIDS Specifics of the tactical situation (e g threat/friendly forces), IFF interrogation reply

Decision(s) required to achieve goal:

Decide to establish AMIRS contact with other formation members

Decide find out formation members position

Decide to adjust AMIRS parameters to cover desired position

Decide to correlate contacts to bull eye position and other sensors

Decide that AMIRS contact has been established

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The precision required when establishing the position of the other formation member is within 10 degrees in bearing/azimuth and 5 degrees in elevation

The AMIRS parameters must be chosen to cover the expected position of the contact, both in azimuth and in elevation

The correlation to other sensors and expected position is to the precision of 10 degrees in bearing/azimuth and 5 degrees in elevation

Physical action(s) required to achieve goal:

Look at displays

Look out

Move and press down on the TDC with left index to adjust parameters on display

Depress pushbuttons on the left DDI to adjust parameters

Look at AMIRS display

Move TDC to move cursers to desired position on AMIRS display

Level of precision/accuracy required to perform the preceding action(s):

High

The level of precision while looking at the displays/look out is 1-2 sec.

The level of precision/accuracy to adjust parameter on the display is to move the index to place the cursers within 1 cm of desired position on the display

2-3 sec precision/accuracy required to analyse the AMIRS display

CF18 Air to Ground IFP Analysis Results

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

AMIRS display

Link 16/MIDS
HUD
Visual
RDR

Factor(s) that influence the achievement of the goal:

Range
Number of contacts on the AMIRS display
Formation member aspect and IR return
IR contrast, Background
Transmissivity
Altitude
Azimuth (within AMIRS coverage, as a minimum)
AMIRS parameters chosen for search (Azimuth and elevation)
Magnification

CF18 Air to Ground IFP Analysis Results

IP Number 7.2 3 2(b) **Goal:** Egress at Low Altitude **Source Task:** 7 2 3 2(b)

Description:

Maintain constant altitude above ground by anticipating rising/descending terrain, and establish appropriate climb or descend Manoeuvre aircraft and visually confirm flight path by looking through Velocity Vector in the HUD Maintain desired Ground Speed by adjusting throttles appropriately Conduct visual Cross Check Perform terrain clearing tasks

Information required to achieve goal:

Aircraft operating procedures. Tactics. Standard Operating procedures Applicable orders, regulations and plans.

Mission requirements and objectives Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc) Details of on-going or planned activities

Aircraft position, heading, flight path, altitude, radar altitude, attitude, speed, g

Routing

Source of information required to achieve goal:

HUD Aircraft position, heading, flight path, altitude, radar altitude, attitude, speed, g, Routing

Visual weather, terrain, Aircraft position, heading, flight path, altitude above ground, attitude, speed, Routing

HSD Aircraft position, heading, speed Routing

Link 16/MIDS Specifics of the tactical situation (e g threat/friendly forces), Details of on-going or planned activities Aircraft position, heading Routing

Seat of the pants Aircraft attitude, speed, g

Decision(s) required to achieve goal:

Decide to Egress at Low Altitude

Decide to change flight path to maintain constant altitude above ground

Decide to follow routing

Decide to adjust ground speed

Decide to conduct visual cross check of information displayed

Decide to look out

Decide to predict flight path ahead and assess terrain

Decide to adjust flight path to miss larger obstacles

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Altitude above the ground maintained at +150ft to -50ft from desired, Heading maintained within 10 degrees, Flight path +5 deg to -1 deg from desired Airspeed within 20 kts

Physical action(s) required to achieve goal:

Look out (repeated)
Look at displays (repeated)
Move stick to roll Aircraft (repeated)
Move throttles to adjust airspeed (repeated)
Pull back on stick to apply g (repeated)
Move stick to adjust flight path (repeated)
Move throttles to adjust airspeed (repeated)

Level of precision/accuracy required to perform the preceding action(s):

Medium

Level of precision required directly linked to the reasoning precision, the degree of the movement of the controls is very small

Type of feedback required to know that goal has been achieved:

Cognitive, Visual

Source of feedback required to know that goal has been achieved:

Visual

CF18 Air to Ground IFP Analysis Results

HUD
Link 16/MIDS

Factor(s) that influence the achievement of the goal:

Threat (Air Defences & air threats)
Fatigue
Speed
Altitude
Position in the formation
Distance from FLOT
ACM (Airspace Control Measures)
ROE
Type of terrain
Fuel remaining
Battle damage
Comfort level

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 5.1(a) **Goal:** Establish Tactical Roles - Tactical Leads and Wingmen **Source Task:** 7 2 5.1(a)

Description:

Individual responsibilities in addition to lookout are

Lead terrain avoidance, navigation, tactical control of the formation, mission leader and bombs on target,

Number three terrain avoidance, back-up navigation, element position keeping, tactical control of number four, deputy mission and tactical lead and bombs on target,

Wingmen: terrain avoidance, position keeping, lookout, bombs on target and monitor sensors

Information required to achieve goal:

Tactics: Standard Operating procedures Applicable orders, regulations and plans Formation responsibilities

Mission, routing, timings

Area of lookout responsibilities

Area of sensor responsibility

Communication procedures/priority

Threats

Position in the formation

Position of other aircraft in the formation

Other aircraft activity in the formation

Aircraft position, altitude, heading, airspeed

Source of information required to achieve goal:

Link 16/MIDS Mission, Threats, Position in the formation, Position of other aircraft in the formation, Other aircraft activity in the formation

RDR: Area of sensor responsibility, Threats, Position of other aircraft in the formation, Other aircraft activity in the formation

AMIRS Area of sensor responsibility, Threats, Position of other aircraft in the formation, Other aircraft activity in the formation

HSD Mission, routing, timings, Threats, Position in the formation, Position of other aircraft in the formation, Other aircraft activity in the formation

HUD Mission, routing, timings, Threats, Position of other aircraft in the formation, Other aircraft activity in the formation, Aircraft position, altitude, heading, airspeed

Comm: Communication procedures/priority, Other aircraft activity in the formation

Visual Area of lookout responsibilities, Position in the formation, Position of other aircraft in the formation, Other aircraft activity in the formation, Aircraft position, altitude, heading, airspeed

Decision(s) required to achieve goal:

Decide to Establish Tactical Roles - Tactical Leads and Wingmen

Decide to avoid terrain

Decide to navigate

Decide to take tactical control of the formation

Decide to take appropriate decision as mission leader

Decide to conduct own attack

Decide to keep position in the formation

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

Many factors required high precision/accuracy in the reasoning This is more a combination of the precision of all different tasks/responsibilities (described in individual tasks)

In addition to the precision of each task, the task of Establishing Tactical Roles - Tactical Leads and Wingmen requires a precision/accuracy of 2-5 sec

CF18 Air to Ground IFP Analysis Results

Decide to Look out

Decide to monitor sensors

Decide to communicate

Decide that the tactical roles are established in the formation

Physical action(s) required to achieve goal:

Look out

Look at displays

Move aircraft controls to manoeuvre aircraft

Move throttles to adjust airspeed

Depress the Comm 1/2 switches

Communicate on the radio

Communicate on the Link 16/ MIDS

Level of precision/accuracy required to perform the preceding action(s):

High

Level of precision directly linked to the reasoning

Type of feedback required to know that goal has been achieved:

Cognitive, Auditory, Visual

Source of feedback required to know that goal has been achieved:

Belief that the tactical roles have been established

Link 16/MIDS
RDR
AMIRS
Comms
Visual
HUD
HSD

Factor(s) that influence the achievement of the goal:

Number of Aircraft in the formation
Experience
Training
Threats
Mission
Comm jamming

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 5 1(b) **Goal:** Maintain Aircraft Control and Flight Position **Source Task:** 7 2 5 1(b)

Description:

Maintain aircraft control and position by adjusting Power, Aircraft pitch and roll to obtain desired Airspeed and Flight Path Adjust Flight position by using airspeed or geometry.

Information required to achieve goal:

Aircraft operating procedures Tactics. Standard Operating procedures. Applicable orders, regulations and plans

Mission requirements and objectives Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc). Details of on-going or planned activities.

Aircraft position, altitude, heading, airspeed, bank angle, flight path, g

Position in the formation

Formation Members position, airspeed, heading, altitude

Bearing/ range to formation member

Closure

Cut off angle

Source of information required to achieve goal:

Visual Specifics of the tactical situation (e.g threat/friendly forces, weather, terrain, etc) Details of on-going or planned activities Aircraft position, altitude, heading, airspeed, bank angle, flight path Position in the formation. Formation Members position, airspeed, heading, altitude. Bearing/ range to formation member Closure Cut off angle

HUD Aircraft position, altitude, heading, airspeed, bank angle, flight path, g Closure

Link 16/MIDS. Specifics of the tactical situation (e g threat/friendly forces, etc.) Details of on-going or planned activities Aircraft position, Position in the formation Formation Members position, heading, altitude. Bearing/ range to formation member Cut off angle

HSD Specifics of the tactical situation (e g threat/friendly forces, etc) Details of on-going or planned activities Aircraft position, heading, airspeed, Position in the formation Formation Members position, heading Bearing/ range to formation member Cut off angle

RDR Specifics of the tactical situation (e g threat/friendly forces, etc) Details of on-going or planned activities Position in the formation Formation Members position, airspeed, heading, altitude. Bearing/ range to formation member Closure Cut off angle

AMIRS Position in the formation, Formation Members position Bearing to formation member Cut off angle

Decision(s) required to achieve goal:

Decide to Maintain Aircraft Control and Flight Position

Decide to look at displays

Decide to look out

Decide to adjust flight path

Decide to adjust airspeed

Decide to establish cut off angle

Decide to use overtake / establish closure

Decide to cross check information on displays

Decision that the aircraft control and flight position are maintained

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Aircraft control should be maintained within 20kts airspeed, 200 ft altitude, 10 deg heading, 10 deg bank angle, 2 deg flight path, 2 g

The flight position should be maintained accurately In close formation, on the wing line +/- 2 deg, elevation +/- 10 ft, range +/- 20 ft For tactical formation, 0-20 deg behind lead wing line

This level of accuracy in the above parameters is very dependent on the situation

CF18 Air to Ground IFP Analysis Results

Physical action(s) required to achieve goal:

Look at displays (repeated)
Look out (repeated)
Look at HUD (repeated)
Move stick to roll Aircraft (repeated)
Move throttles to adjust airspeed (repeated)
Pull back on stick to apply g (repeated)
Move stick to adjust flight path (repeated)

Level of precision/accuracy required to perform the preceding action(s):

Medium

Precision directly linked to the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual
HUD
RDR display
Link 16/MIDS
HSD

Factor(s) that influence the achievement of the goal:

Distance from formation member
Airspeed
Altitude
Energy delta from lead
Threats
Visibility
Eyesight
Background
Aggressiveness

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 5.1(c) **Goal:** Execute Manoeuvre Turns **Source Task:** 7 2.5 1(c)

Description:

Manoeuvre Turns are initiated either via voice on the Discreet frequency or by a wing flash from lead
The check turn is accomplished by turning all formation members simultaneously of the desired angle, while keeping formation Check turns are typically 30 degrees
The in place turn is accomplished by turning all formation members simultaneously to 90-180 degrees
The delayed turn is accomplish by having one formation member turning to the desired heading while the remaining position his aircraft and initiates the turn to maintain formation
The cross turn is accomplished by turning towards each other and reestablishing formation after turn is completed

Information required to achieve goal:

Aircraft operating procedures Tactics Standard Operating procedures Formation keeping procedures

Mission requirements and objectives Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc) Details of on-going or planned activities

Routing

Aircraft heading, altitude, airspeed, Flight path, Altitude above ground

Other formation aircraft's position, heading, bank angle, relative airspeed, altitude, flight path

Turn signal

Decision(s) required to achieve goal:

Decide to execute manoeuvre turn

Decide how many degrees are required in the turn

Decide what type of turn will be used

Decide to signal the turn

Decide to manoeuvre the aircraft

Decide to regain visual contact with formation members (if lost)

Decide to make flight path correction to maintain (or correct to) position in the formation

Decide that the desired heading is established and that the formation position has been regained

Physical action(s) required to achieve goal:

Look at displays (repeated)

Look out (repeated)

Source of information required to achieve goal:

Visual Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc). Routing, Aircraft heading, altitude, airspeed, Flight path, Altitude above ground, Other formation aircraft's position, heading, bank angle, relative airspeed, altitude, flight path, Turn signal

Comms Turn signal

Link 16/MIDS Specifics of the tactical situation (e g threat/friendly forces,etc) Details of on-going or planned activities Other formation aircraft's position Turn signal

HUD Routing, Aircraft heading, altitude, airspeed, Flight path, Altitude above ground

HSD Routing

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The accurate type of turn should be chosen to match the desired amount of degrees and the tactical situation

The position in the formation should be maintained with the precision of 0-20 deg back from the lead wing line, within 3000 ft of altitude, within 30 kts of desired airspeed

The visual contact with other formation member should be regained within 5 sec of regaining formation position

The turn should end up on a heading within 10 degrees of desired

Level of precision/accuracy required to perform the preceding action(s):

Medium

The turn should be communicated clearly and concisely, therefore would warrant a manning of 1-3 sec

CF18 Air to Ground IFP Analysis Results

Communicate turn signal via voice by using the discreet frequency Depress the comm 2 switch on HOTAS and communicate via voice Release comm 2 switch.

Communicate turn signal via Link 16/MIDS by selecting the desire turn via HOTAS or pushbutton

Communicate turn signal via moving the stick laterally to roll aircraft to 90 deg of bank, then roll out.

Manoeuvre aircraft with stick in roll and pitch to execute desired manoeuvre

Pull back on stick to apply required amount of g, then release when no longer required

Adjust throttles as required

The precision/ accuracy in the physical action is directly linked to the precision required in the reasoning.

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visually

Link 16/ MIDS
HUD

Factor(s) that influence the achievement of the goal:

Distance from formation member
Airspeed
Altitude
Type of turn
Number of degrees to be turned
Threats
Configuration
Eyesight
Aggressiveness
SA

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 5.2(a) **Goal:** Optimize Formation for Tactical Situation **Source Task:** 7 2 5 2(a)

Description:

The lead will select the optimal formation for the tactical situation and direct his formation members to adopt formation Wingmen will position their aircraft to optimize formation at the desired range and altitude delta from their lead.

Information required to achieve goal:

Tactics Standard Operating procedures Applicable orders, regulations and plans.

Mission requirements and objectives. Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc)

Aircraft position, heading, altitude, airspeed, Flight path

Current Formation

Range to threat

Source of information required to achieve goal:

Link 16/MIDS Specifics of the tactical situation (e g threat/friendly forces, etc) Current Formation. Range to threat

HUD Aircraft position, heading, altitude, airspeed, Flight path Range to threat

Visual Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc) Aircraft position, heading, altitude, airspeed, Flight path Current Formation Range to threat

RDR Specifics of the tactical situation (e g threat/friendly forces, etc) Current Formation Range to threat

AMIRS Current Formation

HSD Aircraft position, heading, altitude, airspeed, Flight path Current Formation

Decision(s) required to achieve goal:

Decide to optimize formation for tactical situation

Decide to analyse tactical situation

Decide which formation/ position is best suited for situation

Decide to change formation

Decide that the ideal tactical formation is selected and flown

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Some precision required in optimizing the tactical situation for the tactical situation The precision/ accuracy required while attending the goal of optimizing the formation is 1-3 sec

Physical action(s) required to achieve goal:

Look out
Look at displays
Transmit commands via voice
Transmit commands via data link
Move controls to manoeuvre aircraft
Move throttles to adjust/maintain airspeed

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of accuracy is directly related to the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual
Link 16/MIDS
RDR
AMIRS
HSD

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CF18 Air to Ground IFP Analysis Results

Factor(s) that influence the achievement of the goal:

Environment
Threat
Range to threat
Number of aircraft in the formation
Eyesight
SA
Routing/ tasking
Altitude constraints

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 5 2(b) **Goal:** Maintain Visual Mutual Support **Source Task:** 7 2 5 2(b)

Description:

Maintain visual mutual support by maintaining sight of formation members while establishing visual lookout Conduct visual lookout responsibilities

Information required to achieve goal:

Visual lookout technique Tactical formation flying Standard Operating Procedures

Mission Plan Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc).

Aircraft altitude, flight path, speed, environmental conditions.

Formation members position

Presence of threats within area of responsibility

Source of information required to achieve goal:

Visual Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc) Aircraft altitude, flight path, speed, environmental conditions Formation members position Presence of threats within area of responsibility

HUD Aircraft altitude, flight path, speed

Link 16/MIDS Specifics of the tactical situation (e g threat/friendly forces, etc) Formation members position Presence of threats within area of responsibility

Decision(s) required to achieve goal:

Decide to maintain visual mutual support

Decide to maintain visual contact with formation members

Decide to actively and methodically scan surroundings

Decide focus distance

Decide on type of scan pattern

Decide that all aspects of a proper visual lookout are conducted, including maintaining visual contact with other formation members

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The visual lookout requires the pilot to be methodical and precise to be effective in his approach to scanning the surroundings

The pilot should select the appropriate quadrant to conduct his look out while maintaining visual contact with formation members, and alternate between them based on a priority system and a % of importance (varies with the situation)

Focus distance within 2 nm of desired (this precision decreases with range)

The precision/accuracy in attending the goal of maintaining visual contact with formation members is 0 5-3 sec

The precision/accuracy in attending the goal of Visual lookout requires 6-12 sec (Less quadrants to cover in responsibility due to mutual support)

The level of precision required each time the pilot looks out to scan one of the quadrants is 2-4 sec

Physical action(s) required to achieve goal:

Look at HUD/displays

Look out by visually scanning the outside world in a pattern that covers area of responsibility.

Level of precision/accuracy required to perform the preceding action(s):

Medium

The visual look out follows a preset pattern to be more effective

The precision in the physical actions is directly linked to the reasoning

CF18 Air to Ground IFP Analysis Results

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual

RWR
Link 16/MIDS

Factor(s) that influence the achievement of the goal:

Environment / Background
Sun's position
Number of aircraft in the formation
Eyesight
Focus distance
Size and aspect of visual contacts
Visual cues from visual contacts (ex : smoke, contrails, movement)
Distance from formation members
Other tasking (Time share)

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 5 2(c) **Goal:** Maintain Positional Mutual Support **Source Task:** 7 2 5.2(c)

Description:

Positional mutual support is maintained by keeping SA on formation members position utilizing sensors and data link Remain within sensor and weapons range to support formation members

Information required to achieve goal:

Tactics Applicable orders, regulations and plans Standard Operating Procedures Sensor displays and symbology interpretation

Mission Plan Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc)

Aircraft position, altitude, flight path, speed

Formation members position

Presence of threats within area of responsibility

Source of information required to achieve goal:

HUD Aircraft position, altitude, flight path, speed Formation members position Presence of threats within area of responsibility

Link 16/MIDS Specifics of the tactical situation (e g threat/friendly forces, etc). Aircraft position. Formation members position Presence of threats within area of responsibility

RDR: Specifics of the tactical situation (e g threat/friendly forces, etc) Formation members position. Presence of threats within area of responsibility

AMIRS Specifics of the tactical situation (e g threat/friendly forces, etc) Formation members position Presence of threats within area of responsibility

HSD Specifics of the tactical situation (e g threat/friendly forces, etc) Aircraft position, Formation members position Presence of threats within area of responsibility

DEWS/RWR Specifics of the tactical situation (e g threat/friendly forces, etc). Presence of threats within area of responsibility

Decision(s) required to achieve goal:

Decide to maintain positional mutual support

Decide to maintain SA on formation members position

Decide to actively and methodically scan surroundings with sensors

Decide to remain within appropriate range to support formation members

Decide that awareness and good positioning is maintained on other formation members and/or formation elements using non visual methods

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The precision/accuracy in attending the goal of maintaining positional mutual support is 1-3 sec

Physical action(s) required to achieve goal:

Look at HUD

Look at Link 16/MIDS

Look at sensors

Look at RWR/ DEWS information

Move controls to manoeuvre aircraft

Level of precision/accuracy required to perform the preceding action(s):

Medium

The precision in the physical actions is directly linked to the reasoning

CF18 Air to Ground IFP Analysis Results

Move throttles to adjust airspeed

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Link 16/MIDS
RDR
AMIRS
HSD
HUD

Factor(s) that influence the achievement of the goal:

Number of aircraft in the formation
Distance from formation members
Other tasking (Time share)
Threats
Type of weapons on board
ROE
Acceptable Risk level

CF18 Air to Ground IFP Analysis Results

IP Number 7.2.5 2(c) **Goal:** Maintain Visual Mutual Support with NVG **Source Task:** 7 2 5 2(c)

Description:

Maintain visual mutual support by maintaining sight with NVG of formation members while establishing visual lookout Conduct visual lookout responsibilities

Information required to achieve goal:

NVG Visual lookout technique. Night NVG tactical formation flying Standard Operating Procedures

Mission Plan Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc.).

Aircraft altitude, flight path, speed

Environmental conditions, visibility, Lighting conditions

Formation members position

Presence of threats within area of responsibility

Source of information required to achieve goal:

Visual Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc.) Aircraft altitude, flight path, speed Environmental conditions, visibility, Lighting conditions. Formation members position Presence of threats within area of responsibility

HUD Aircraft altitude, flight path, speed

Link 16/MIDS Specifics of the tactical situation (e g threat/friendly forces, etc) Formation members position Presence of threats within area of responsibility

Decision(s) required to achieve goal:

Decide to maintain visual mutual support with NVG

Decide to maintain NVG visual contact with formation members

Decide to actively and methodically scan surroundings

Decide on type of scan pattern

Decide that all aspects of a proper NVG visual lookout are conducted, including maintaining NVG visual contact with other formation members

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The visual lookout with NVG requires the pilot to be methodical and precise to be effective in his approach to scanning the surroundings.

The pilot should select the appropriate quadrant to conduct his look out while maintaining visual contact with formation members, and alternate between them based on a priority system and a % of importance (varies with the situation)

The precision/accuracy in attending the goal of maintaining NVG visual contact with formation members is 1-3 sec.

The precision/accuracy in attending the goal of NVG Visual lookout requires 9-15 sec (Less quadrants to cover in responsibility due to mutual support)

The level of precision required each time the pilot looks out with NVG to scan one of the quadrants is 3-5 sec

Physical action(s) required to achieve goal:

Look at HUD/displays

Look out by visually scanning the outside world in a pattern that covers area of responsibility.

Level of precision/accuracy required to perform the preceding action(s):

Medium

The visual look out with NVG follows a preset pattern to be more effective

CF18 Air to Ground IFP Analysis Results

The precision in the physical actions is directly linked to the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual

RWR
Link 16/MIDS

Factor(s) that influence the achievement of the goal:

Environment
Lighting intensity (Moon, cities...)
Range
NVG FOV
Number of aircraft in the formation
Eyesight
Size and aspect of visual contacts
Visual cues from visual contacts (ex., movement, lights)
Distance from formation members
Other tasking (Time share)

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 5 2(f) **Goal:** Communicate with Formation Members via Discreet Frequency **Source Task:** 7 2 5 2(f)

Description:

Communicate to other formation Members by pressing on the HOTAS radio switch

Information required to achieve goal:

Systems knowledge (radio) Standard radio terminology

Information to be passed on, External cues

That the frequency is free/not being used

That the proper frequency is dialed

Source of information required to achieve goal:

Headphones That the frequency is free/not being used

UFC That the proper frequency is dialed

Decision(s) required to achieve goal:

Decide to communicate with formation members

Decide what information to communicate

Decide what frequency/radio to communicate on

Decide that the frequency is free

Decide to transmit on the frequency

Decide that the information has been communicated

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The pilot has to clearly think and formulate his communication before he transmits, usually following standard terminology The level of precision/ accuracy is between 2-5 sec while attending the goal of communicating with formation members

Physical action(s) required to achieve goal:

Look at UFC

Select desired frequency (if required) by pulling/turning the preset buttons, or by typing in the frequency on the UFC

Listen on the frequency

Depress the comm 2 switch with left thumb

Speak in the microphone

Level of precision/accuracy required to perform the preceding action(s):

Medium

Precision/accuracy in the physical actions required while selecting the frequency When the desired frequency has to be selected via presets, precision of +/- 0, or via selecting the frequency manually, again requiring a precision of +/- 0

The accuracy while depressing the comm 2 button is required to ensure that the desired radio is used, therefore a precision of ~ 1 cm while depressing the comm 2 switch

Accuracy is required while speaking on the radio and is directly related to the precision required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Auditory, Cognitive

Source of feedback required to know that goal has been achieved:

UFC

Headphones

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Distance from formation members
Quantity of communication on the frequency
Comm Jamming
Quality / condition of microphone
Amount of g while communicating
Stress / Excitement

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6 1(a) **Goal:** Maintain Ground Track **Source Task:** 7 2 6 1(a)

Description:

Accurately follow the Ground Track information displayed in the HSD and HUD Fly on the displayed heading required to the next waypoint Monitor heading, drift, routing and ground track information. Make appropriate heading corrections to regain and maintain desired ground track

Information required to achieve goal:

Aircraft operating procedures Standard Operating procedures
Sensor displays and symbology interpretation. Basic navigation techniques

Specific routing and/or map Mission Plan

Aircraft position, heading

Winds

Source of information required to achieve goal:

HSD Specific routing and/or map. Mission Plan Aircraft position, heading Winds

HUD Aircraft position, heading

Visual Specific routing and/or map Mission Plan Winds

Decision(s) required to achieve goal:

Decide to Maintain Ground Track

Decide to look at HSD

Decide to fly aircraft according to the displayed routing

Decide to make corrections to ground track (if required)

Decide that that correct ground track is maintained

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The aircraft should be flown within 5 degrees of the required heading, and stay within 0 5 nm of track

The level of precision in attending the Maintaining ground track tasks is 0 5- 1 sec every time the pilot assesses the ground track/aircraft position on the HSD

Physical action(s) required to achieve goal:

Look at HSD
Look out
Move aircraft controls to fly aircraft along the ground track

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, cognitive

Source of feedback required to know that goal has been achieved:

HSD

Visual
HUD

Factor(s) that influence the achievement of the goal:

Aircraft INS/GPS precision
Winds
Ability to fly along the displayed routing

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6 1(b) **Goal:** Adhere to ACO **Source Task:** 7 2 6 1(b)

Description:

Adhere to Air Coordination Order by accurately following the ACO routing displayed on the HSD. Follow ACO Airspeed, Altitude and routing restrictions

Information required to achieve goal:

Sensor displays and symbology interpretation Applicable orders, regulations and plans Standard Operating procedures

Specific ACO routing and/or map. Mission Plan.

Aircraft position, heading, altitude, airspeed

Winds

Threat location

Tactical situation

Source of information required to achieve goal:

HSD Specific ACO routing and/or map Mission Plan Aircraft position, heading, airspeed Winds Threat location

HUD Aircraft position, heading, altitude, airspeed Winds.
Threat location

Visual: Specific ACO routing and/or map Mission Plan Aircraft position, heading, altitude, airspeed Winds Threat location

Link 16/MIDS: Tactical situation Threat location Specific ACO routing and/or map Mission Plan.

Decision(s) required to achieve goal:

Decide to Adhere to ACO

Decide to look at HSD

Decide to look at displays

Decide to fly aircraft according to the ACO routing

Decide to make corrections to ground track (if required)

Decide to adjust Altitude and Airspeed to ACO requirements

Decide that all aspects of an Air Coordination Order are followed

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The aircraft should be flown within 5 degrees of the required heading, and stay within 0 5 nm of track Airspeed with 20 kts, altitude within 200 ft

The level of precision in attending the adherence to ACO is 0 5- 2 sec

Physical action(s) required to achieve goal:

Look at HSD
Look at displays
Look out
Move aircraft controls to fly aircraft along the ACO ground track
Move throttles to adjust airspeed

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Cognitive, Visual

Source of feedback required to know that goal has been achieved:

HSD
HUD
Link 16/MIDS

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Aircraft INS/GPS precision
Winds
Ability to fly along the displayed ACO routing
Threats
Weather
Fuel remaining
Battle damage
Hung weapons
Other tasking

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6 1(c) **Goal:** Adjust G/S to Make Tasking Timings **Source Task:** 7 2 6 1(c)

Description:

Adjust G/S by increasing or decreasing IAS Monitor ETA over waypoint on the HSD and fine tune G/S as required to arrive at required timing

Information required to achieve goal:

Aircraft operating procedures Standard Operating procedures
Sensor displays and symbology interpretation

Specific route and/or map Mission Plan Winds

Aircraft position, heading, Current ground speed, ground speed required

ETA over next waypoint/ ETA over target

Ground references

Specific routing and/or map Mission Plan

Aircraft position, speed

Source of information required to achieve goal:

HSD. Specific route and/or map. Mission Plan Winds Aircraft position, heading, Current ground speed, ground speed required ETA over next waypoint/ ETA over target

HUD Aircraft position, heading, speed Current ground speed, ground speed required.

Visual Ground references

Decision(s) required to achieve goal:

Decide to Adjust G/S to make Tasking Timings

Decide to look at HUD

Decide to look at HSD

Decide to fly aircraft according to the required G/S

Decide to make corrections to G/S (if required)

Decide that correct groundspeed is flown in order to comply with timings

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Airspeed should be flown within 20 kts Timings to be on Target within 5 sec.

The level of precision in attending the Adjust G/S tasks is 0 5- 1 sec every time the pilot assesses the ground speed / timings on the HSD.

Physical action(s) required to achieve goal:

Look at HSD
Look at HUD
Look out
Move aircraft throttles and controls to fly aircraft at the desired G/S

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

HSD

HUD
Visual

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Aircraft INS/GPS precision
Winds
Accuracy of System updates
Ability to fly required G/S
Terrain
Threats

CF18 Air to Ground IFP Analysis Results

IP Number 7.2 6 1(d) **Goal:** Monitor and Avoid ACO Restricted Areas **Source Task:** 7.2 6 1(d)

Description:

Avoid ACO restricted areas by monitoring HSD displayed information and verifying information on the Area MAP

Information required to achieve goal:

Sensor displays and symbology interpretation. Applicable orders, regulations and plans Standard Operating procedures

Specific ACO routing and/or map. Mission Plan ACO restricted areas location

Aircraft position, heading, altitude, airspeed.

Winds

Source of information required to achieve goal:

HSD Specific ACO routing and/or map Mission Plan ACO restricted areas location. Aircraft position, heading, airspeed Winds

HUD Aircraft position, heading, altitude, airspeed Winds.

Visual: Specific ACO routing and/or map Mission Plan ACO restricted areas location Aircraft position, heading, altitude, airspeed. Winds

Link 16/MIDS Specific ACO routing and/or map Mission Plan ACO restricted areas location

Decision(s) required to achieve goal:

Decide to Monitor and Avoid ACO Restricted Areas

Decide to look at HSD

Decide to look at displays

Decide to fly aircraft in order to avoid ACO restricted areas

Decide to make corrections to ground track (if required)

Decide that all Air Coordination Order restricted area's are avoided

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The aircraft should be not be flown in the restricted areas Aim to stay outside of 1nm from restricted areas borders.

The level of precision in attending the monitor and avoid ACO restricted areas is 0 5- 1 sec.

Physical action(s) required to achieve goal:

Look at HSD
Look at displays
Look out
Move aircraft controls to fly aircraft and avoid ACO restricted areas
Move throttles to adjust airspeed

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Cognitive, Visual

Source of feedback required to know that goal has been achieved:

HSD
HUD
Link 16/MIDS

Factor(s) that influence the achievement of the goal:

Aircraft INS/GPS precision
Location of restricted areas
Activity in the restricted area
Winds

CF18 Air to Ground IFP Analysis Results

Threats
Weather
Fuel remaining
Battle damage
Hung weapons
Other tasking

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6 2(a) **Goal:** Navigate Using Visual References **Source Task:** 7 2 6 2(a)

Description:

Conduct Navigation by visually finding ground references to verify that the correct routing is followed.

Information required to achieve goal:

Basic navigation techniques. Symbology interpretation

Mission requirements and objectives Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc)

Specific route and/or map Mission Plan

Aircraft position, heading, speed

Ground references

Source of information required to achieve goal:

Visual Specifics of the tactical situation (e.g threat/friendly forces, weather, terrain, etc) Specific routing and/or map. Mission Plan Aircraft position, heading, speed Ground references

Link 16/MIDS Specifics of the tactical situation (e g threat/friendly forces, etc)

HUD Aircraft position, heading, speed

Decision(s) required to achieve goal:

Decide to Navigate using visual references

Decide to look out

Decide to look at HUD

Decide to fly aircraft according to the route and/or map

Decide to make corrections to navigation (if required)

Decide that correct navigation is carried out and confirmed through visual ground references

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The aircraft should be flown within 5 degrees of the required heading, and stay within 0 5 nm of track Airspeed should be flown within 10 kts Timing within 10 sec of desired

The level of precision in attending the navigation tasks is 2-5 sec every time the pilot assesses the routing/aircraft position visually

Physical action(s) required to achieve goal:

Look at HUD
Look at other displays
Look out
Move aircraft controls to fly aircraft along the displayed routing

Level of precision/accuracy required to perform the preceding action(s):

High

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual
HUD

Factor(s) that influence the achievement of the goal:

Winds
Ability to fly along the displayed routing
Ground features
Precision in flying heading/airspeed

CF18 Air to Ground IFP Analysis Results

IP Number 7.2 6 2(b) **Goal:** Navigate Using Sensors Information Displayed on HSD and DDIs **Source Task:** 7.2 6 2(b)

Description:

Select routing on the HSD. System navigation in the CF-18 is simply a matter of following the displayed routing information on the HSD

Information required to achieve goal:

Aircraft operating procedures Standard Operating procedures.
Sensor displays and symbology interpretation Basic navigation techniques

Mission requirements and objectives Specifics of the tactical situation (e.g threat/friendly forces, weather, terrain, etc)

Specific routing and/or map Mission Plan

Aircraft position, heading, speed

Source of information required to achieve goal:

HSD Specifics of the tactical situation (e.g threat/friendly forces, etc) Specific routing and/or map. Mission Plan Aircraft position, heading, speed.

Link 16/MIDS: Specifics of the tactical situation (e.g threat/friendly forces, etc.)

HUD Aircraft position, heading, speed

Visual weather, terrain, Specific routing and/or map Mission Plan

Decision(s) required to achieve goal:

Decide to Navigate using aircraft systems

Decide to look at HSD

Decide to select desired routing on the HSD

Decide to fly aircraft according to the displayed routing

Decide to make corrections to navigation (if required)

Decide that the aircraft is on the correct route

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The aircraft should be flown within 5 degrees of the required heading, and stay within 0 5 nm of track
Airspeed should be flown within 20 kts

The level of precision in attending the navigation tasks is 0 5- 2 sec every time the pilot assesses the routing/aircraft position on the HSD

Physical action(s) required to achieve goal:

Look at HSD
Look at other displays
Look out
Push appropriate pushbutton on HSD to select routing
Move aircraft controls to fly aircraft along the displayed routing

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

HSD

Visual
AMIRS
RDR
Link 16/MIDS

Factor(s) that influence the achievement of the goal:

Aircraft INS/GPS precision
Winds

CF18 Air to Ground IFP Analysis Results

Switchology errors
Programming errors
Accuracy of LAT/ LONG coordinates provide to the aircraft
Accuracy of System updates
Ability to fly along the displayed routing

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6 2(c) **Goal:** Perform Navigation Systems Designations/Updates **Source Task:** 7 2 6 2(c)

Description:

NAVDSG Conduct a NAVDSG by first selecting the desired WAYPOINT/OAP on the HSD Then press (tile 15) on the HSD

Over fly Designation First, ensure you are in NAV or A/G Master mode, then assign the TDC to the HSD and depress the TDC when you are accurately positioned over the point you want to designate

HUD Reticle Designation. Select the system in NAV or A/G Master Mode and undesignate Ensure that the weapons system is in AUTO, and assign the TDC to the HUD Manoeuvre the a/c until the reticle is over the target and press the pickle button, or action the TDC

HUD TD Designation With the TDC assigned to the HUD press the TDC If the system was already designated, slew the segmented TDdiamond to the desired location within the HUD If the system is not already designated, press the TDC to designate an aim point based on the following priorities
at the reticle LOS if displayed; or at the velocity vector LOS or 7 5 below the horizon which ever is steeper.

Radar Cursor Designation With the TDC assigned to the radar, and the cursor on the radar screen, depress the TDC The TDC can then be slewed as required to designate a point If an aim point was already designated then depressing the TDC will allow sweetening of the aim point; and

Radar Tracking Designation With the TDC assigned to the radar, and the cursor on the radar screen, or the designated aim point already assigned, use the sensor control switch (castle switch) to assign the TDC to the radar again Hold the castle switch to the right while slewing the cursors using the TDC to slew the cursors

AMIRS designation. Assign the TDC to the AMIRS display via the castle switch Depress the TDC to designate a target Slew TDC to move designation

Designation updates
Procedure
perform a designation (HUD, Rdr, Amirs, and OVERFLY),
UPDT - PRESS,
DSG - PRESS; and
ACCEPT or REJECT.

Information required to achieve goal:

Aircraft operating procedures. Tactics Standard Operating procedures. Designation procedures Sensor displays and symbology interpretation.

Mission Plan Update point knowledge (terrain, large features surrounding Point, smaller unique features, weather, etc.)

Update point Area features

Specific update point features

Update point location

Aircraft Master mode selection, TDC assignment location,

Update point exact coordinates

Source of information required to achieve goal:

HUD. TDC assignment location, Update point location, Update point information

Visual Update point location, Update point Area features Specific update point features

Radar. TDC assignment location, Update point location Update point Area features Specific update point features

AMIRS: TDC assignment location, Update point location Update point Area features Specific update point features

HSD Details of on-going or planned activities, TDC assignment location, Update point location

Link 16/MIDS Specifics of the tactical situation, Details of on-going or planned activities

Aircraft Master Mode Light Aircraft Master mode selection

Decision(s) required to achieve goal:

Type of reasoning required to achieve goal:

CF18 Air to Ground IFP Analysis Results

Decide to select Master mode

Decide to Nav designate the Update point (if required)

Decide to assign TDC

Decide to adjust Aircraft position / designation position

Decide that Aircraft/designation is over the Update point

Decide to designate Update point

Decide to update navigation system (if required)

Decide that the designation / update are accurate

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The accuracy required when the pilot designates the Update point is mostly in the procedure to achieve the goal The pilot has to follow specific steps to be successful

The level of accuracy/precision required while the pilot is performing an overfly designation is 3 sec

The update is performed with the accuracy of 2 sec

The level of accuracy/ precision while the pilot is performing a HUD designation, sensor designation is 5 sec

Physical action(s) required to achieve goal:

Nav designation.
Push on HSD pushbuttons to select Update point
Push on the Navdes pushbutton

Over fly designation
Push the Master Mode switch (If required) Left hand
Look at the Master Mode light
Move castle switch down (assign TDC to HSD) with right thumb
Look at HSD
Look out at Update point
Move aircraft controls to fly over Update point
Depress TDC with left index
Look at HUD

HUD designation
Push the Master Mode switch (If required) Left hand
Look at the Master Mode light
Depress NAVDES push button on HSD (if required)
Move castle switch up (assign TDC to HUD) with right thumb
Move aircraft controls to aim at the Update point (if required)
Depress / Move TDC switch with left index (TD/reticle designation)
Depress the pickle button with right thumb (Reticle designation)
Look at HUD

Sensor designation
Push the Master Mode switch (If required) Left hand
Look at the Master Mode light
Depress NAVDES push button on HSD
Move castle switch left or right (assign TDC to L/R DDI) with right thumb
Depress / Move TDC switch with left index
Look at Display

Level of precision/accuracy required to perform the preceding action(s):

High

Level of precision/accuracy is based on actioning the proper switches at the required time, and while performing the designation, the action of designating a point has to be accurate.

For the overfly designation, the pilot requires to fly the aircraft accurately over the Update point location, within 500 ft laterally. The pilot has to depress the TDC within 1 sec of overflying the specific Update point location

For a HUD designation, the designation symbol has to be within 1 deg of update point location.

For a sensor designation, the pilot has to position the cursers/ TD diamond within 3 mm of the desired position on the display.

CF18 Air to Ground IFP Analysis Results

Updates
Push the UPDT on the HSD
Push the DSG on the HSD
Push the ACCEPT or REJECT on the HSD

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

HUD
HSD
Sensor displays

Factor(s) that influence the achievement of the goal:

Altitude
Speed
Threats
INS platform accuracy
Correction / Manoeuvering required to designate IP
Ease of pinpointing desired position
Environment
Switchology errors
Line of sight errors (pilot not at the designed eye position)

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6.2(d) **Goal:** Employ Watch Map Ground Technique **Source Task:** 7 2 6 2(d)

Description:

The Elapsed Time is checked and a point ahead of the associated Elapsed Time marking on the map is selected for identification When this point is identified on the ground then the navigation errors can be determined and a correction can be made Common methods for correcting back to track or for getting back on time are Track corrections and Time corrections

Information required to achieve goal:

Basic navigation techniques

Specific route and/or map Mission Plan Weather conditions, visibility, winds, sun, terrain.

Current time (Elapsed or Time of Day)
Current position
Predicted position
Desired time over predicted position
Time error
Track error

Source of information required to achieve goal:

HUD Current time (Elapsed or Time of Day), Current position, Time error

HSD Current time (Elapsed or Time of Day), Current position, Time error, Track error

Map Current position, Predicted position, Desired time over predicted position, Track error

Look out Current position, Predicted position, Track error

Decision(s) required to achieve goal:

Decide to find out present time

Decide to find out present position

Decide to select a point ahead on the Map

Decide to search and find that point on the ground

Decide to determine time and track errors

Decide to make Time and Track corrections

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The pilot finds a point on the Map along the predicted track and pinpoint the position over that as accurately as the width of the drawn line on the Map He then estimates the time over that position by reading timing marks on the MAP (Marks at every 10 sec on a run in Map)

The pilot aims to estimate his current position within 1000ft, and the time over that position within 2 sec

Physical action(s) required to achieve goal:

Look at time on HUD or HSD
Look out at present position
Look at MAP
Look out at point ahead
Move Stick to change Aircraft track / flight path
Move throttles

Level of precision/accuracy required to perform the preceding action(s):

High

The pilot will attempt to fly Aircraft on the desired track (within 2000ft) and adjust the required Ground speed (Within 10 kts) to achieve as close to the desired timing as possible (within 5 sec)

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

HUD
HSD
Ground features

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Map Scale
Winds
Visibility
Eyesight
Speed
Altitude
Size of features
Similarity to surrounding features
Type of terrain (Desert vs Lake and rivers)
Threats
Turns

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6 2(e) **Goal:** Arrive at Target at Predetermined TOT **Source Task:** 7 2 6 2(e)

Description:

Adjust G/S and routing to arrive at target at predetermined TOT

Information required to achieve goal:

Sensor displays and symbology interpretation. Basic navigation techniques

Specific route and/or map Mission Plan

Aircraft position, heading, Current ground speed, ground speed required

ETA over target

Threat location

Winds

Ground references

Specific routing and/or map Mission Plan

Source of information required to achieve goal:

HSD· Specific route and/or map Mission Plan Winds Aircraft position, heading, Current ground speed, ground speed required ETA over target Threat location

HUD Aircraft position, heading, speed Current ground speed, ground speed required

Visual Ground references, Aircraft position, heading

Link 16/ MIDS· Specific route, Mission Plan. Threat location

Decision(s) required to achieve goal:

Decide to Arrive at Target at Predetermined TOT

Decide to look at Displays/ look out

Decide to analyse predicted TOT

Decide to adjust G/S

Decide to adjust routing

Decide that the Time on Target is achieved accurately through adjustments of aircraft speed and routing

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

Airspeed should be flown within 20 kts. Timings to be on Target within 5 sec

The level of precision in attending the Adjust G/S tasks is 0 5- 1 sec every time the pilot assesses the ground speed / timings on the HSD.

Start turn towards next waypoint/target when the planned time of day over that waypoint is displayed +/- 10sec

Physical action(s) required to achieve goal:

Look at displays
Look out
Move aircraft throttles to adjust G/S
Move aircraft controls to manoeuvre aircraft

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

HSD

Visual

CF18 Air to Ground IFP Analysis Results

HUD

Factor(s) that influence the achievement of the goal:

Aircraft INS/GPS precision
Winds
Ability to fly required G/S
Terrain
Threats
Mission requirements (is possible to change routing?)
Amount of correction required
Fuel
Planning (Were dog legs planned to allow to cut corners?)

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6 2(f) **Goal:** Navigate Using NVG Visual References **Source Task:** 7 2 6 2(f)

Description:

Conduct Navigation by visually finding ground references with NVG to verify that the correct routing is followed

Information required to achieve goal:

Mission requirements and objectives Specifics of the tactical situation (e.g threat/friendly forces, terrain, etc)

NVG lookout techniques Sensor displays and symbology interpretation Basic navigation techniques

Specific route and/or map Mission Plan

Weather conditions, visibility, ambient light.

Aircraft position, heading, speed

Ground references

Source of information required to achieve goal:

Visual. Specifics of the tactical situation (e g threat/friendly forces, terrain, etc) Specific routing and/or map Mission Plan Weather conditions, visibility, ambient light Aircraft position, heading, speed Ground references

Link 16/MIDS Specifics of the tactical situation (e g threat/friendly forces, etc.)

HUD Aircraft position, heading, speed

Decision(s) required to achieve goal:

Decide to Navigate using NVG visual references

Decide to look out

Decide to look at HUD information

Decide to fly aircraft according to the route and/or map

Decide to make corrections to navigation (if required)

Decide that correct navigation is carried out and confirmed through NVG visual ground references

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The aircraft should be flown within 5 degrees of the required heading, and stay within 0 5 nm of track Airspeed should be flown within 10 kts Timing within 10 sec of desired

The level of precision in attending the navigation tasks is 3-10 sec every time the pilot assesses the routing/aircraft position visually

Physical action(s) required to achieve goal:

Look at HUD information
Look at other displays
Look out
Move aircraft controls to fly aircraft along the displayed routing

Level of precision/accuracy required to perform the preceding action(s):

High

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual

HUD Information

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Winds
Ability to fly along the displayed routing
Ground features
Precision in flying heading/airspeed
Lighting
Altitude

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6.3(a) **Goal:** Monitor and Avoid Weather **Source Task:** 7.2 6 3(a)

Description:

Monitor by visually looking outside the cockpit at significant weather build ups Adjust sensors parameter to optimize weather detection and monitor displayed weather on the DDIs Avoid weather by changing routing and flight profile

Information required to achieve goal:

Basic Flying Sensor displays and symbology interpretation.

Visual Lookout Cues. Radar cues Study of weather forecast and actual weather

Type of cloud, Ceiling, Top of could layer

Routing, mission requirements

Source of information required to achieve goal:

Visual. Visual Lookout Cues, Type of cloud, Ceiling, Top of could layer

RDR· Radar cues, Type of cloud, Top of could layer

HSD Routing, mission requirements

AMIRS Type of cloud, Ceiling, Top of could layer

Decision(s) required to achieve goal:

Decide to Monitor and Avoid Weather

Decide to look at displays

Decide to optimize sensor image

Decide to look out

Decide to assess weather

Decide to adjust routing/flight profile

Decide that all significant weather is avoided using both visual and sensor cues

Type of reasoning required to achieve goal:

knowledge

Level of precision/accuracy required for the above type of reasoning:

Medium

The level of precision/accuracy in monitoring and avoiding weather requires 1-3 sec every time the weather is assessed and actions are planned

Physical action(s) required to achieve goal:

Look out
Look at displays
Move castle switch to assign TDC
Move TDC to adjust sensor parameters
Push display pushbuttons to adjust sensor parameters
Move aircraft controls to manoeuvre aircraft
Move aircraft throttles to adjust airspeed

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive, psychomotor

Source of feedback required to know that goal has been achieved:

Visual

RDR
AMIRS
HSD

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Type of weather
Routing (Restricted?)
Other aircraft in the Area
Mission plan
Type of weapon to be delivered
Threats
Icing/freezing level
temperature

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6 3(b) **Goal:** Monitor and Avoid Obstacles **Source Task:** 7 2 6 3(b)

Description:

Monitor obstacles visually Avoid obstacles by changing routing and flight path

Information required to achieve goal:

Basic Flying.

Visual Lookout Cues Knowledge of area obstacles (map study)

Specific mission plan

Type of obstacles, height

Aircraft Altitude, airspeed, heading, flight profile

Source of information required to achieve goal:

Visual· Visual Lookout Cues Type of obstacles, height Aircraft Altitude, airspeed, heading, flight profile

HSD· Knowledge of area obstacles (map study) Specific mission plan.

Map Knowledge of area obstacles (map study) Specific mission plan

AMIRS Type of obstacles, height

RDR. Type of obstacles, height

HUD. Aircraft Altitude, airspeed, heading, flight profile

Decision(s) required to achieve goal:

Decide to monitor and avoid obstacles

Decide to look out

Decide to look at displays

Decide to optimize sensor image

Decide to assess obstacles

Decide to adjust routing/flight profile

Decide that all obstacles are avoided

Type of reasoning required to achieve goal:

knowledge

Level of precision/accuracy required for the above type of reasoning:

High

The level of precision/accuracy in monitoring and avoiding obstacles requires 1-3 sec every time the obstacles are assessed and corrective actions are planned Avoid obstacles by 500ft in altitude and 1000ft laterally.

Physical action(s) required to achieve goal:

Look out
Look at displays
Move castle switch to assign TDC
Move TDC to adjust sensor parameters
Push display pushbuttons to adjust sensor parameters
Move aircraft controls to manoeuvre aircraft
Move aircraft throttles to adjust airspeed

Level of precision/accuracy required to perform the preceding action(s):

High

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual

RDR

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CF18 Air to Ground IFP Analysis Results

AMIRS
HSD

Factor(s) that influence the achievement of the goal:

Type of obstacles
Routing (Restricted?)
Other aircraft in the Area
Mission plan
Threats
Proximity to obstacles

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6 3(c) **Goal:** Monitor and Avoid Terrain **Source Task:** 7 2 6 3(c)

Description:

At all times while flying in the low-level environment the primary task is terrain clearance Monitor terrain visually. Avoid terrain by changing flight path

Information required to achieve goal:

Basic Flying

Visual Lookout Cues Knowledge of area terrain (map study) Specific mission plan

Type of terrain, height, size/type of features on ground

Aircraft altitude above ground, airspeed, heading, flight profile

Specific mission plan

Source of information required to achieve goal:

Visual Visual Lookout Cues Type of terrain, height, size/type of features on ground Aircraft altitude above ground, airspeed, heading, flight profile

HUD Aircraft Radar altitude, airspeed, heading, flight profile

RDR Type of terrain, height, size/type of features on ground

AMIRS Type of terrain, height, size/type of features on ground

HSD Knowledge of area terrain (map study) Specific mission plan

MAP Knowledge of area terrain (map study) Specific mission plan

Decision(s) required to achieve goal:

Decide to monitor and avoid terrain

Decide to look out

Decide to look at displays

Decide to assess terrain

Decide to adjust routing/flight profile

Decide that all terrain is avoided

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The level of precision/accuracy in monitoring and avoiding terrain requires 0 5-2 sec every time the terrain is assessed and corrective actions are planned Avoid terrain by min of 100ft in altitude and 1000ft laterally.

Physical action(s) required to achieve goal:

Look out
Look at displays
Move aircraft controls to manoeuvre aircraft
Move aircraft throttles to adjust airspeed

Level of precision/accuracy required to perform the preceding action(s):

High

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive, Auditory

Source of feedback required to know that goal has been achieved:

Visual

HUD
Audio

Factor(s) that influence the achievement of the goal:

Type of obstacles
Routing (Restricted?)

CF18 Air to Ground IFP Analysis Results

Other aircraft in the Area
Mission plan/requirements
Threats
Comfort level
Other taskings
Speed
Sun position
Weather

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 6 3(e) **Goal:** Monitor and Avoid Other Aircraft **Source Task:** 7 2 6 3(e)

Description:

Monitor other Aircraft by establishing cross check between visual look out and sensor information displayed on the HUD and DDIs Avoid other Aircraft by changing flight path

Information required to achieve goal:

Basic Flying. Rules of the road.

Visual Lookout Cues Specific mission plan

Aircraft altitude, airspeed, heading, flight profile

Other aircraft position, altitude, heading, flight profile, speed

Collision course

Source of information required to achieve goal:

Visual· Visual Lookout Cues Aircraft altitude, airspeed, heading, flight profile Other aircraft position, altitude, heading, flight profile, speed Collision course

Link 16/MIDS· Specific mission plan

RDR Other aircraft position, altitude, heading, flight profile, speed Collision course

AMIRS Other aircraft position, flight profile

HSD Specific mission plan

HUD Aircraft altitude, airspeed, heading, flight profile Other aircraft position, altitude, heading, flight profile, speed. Collision course

Decision(s) required to achieve goal:

Decide to monitor and avoid other aircraft

Decide to look out

Decide to look at displays

Decide to assess collision potential

Decide to adjust flight path

Decide that all other aircraft are avoided

Type of reasoning required to achieve goal:

knowledge

Level of precision/accuracy required for the above type of reasoning:

High

The level of precision/accuracy in monitoring and avoiding other aircraft requires 0 5-3 sec every time the collision potential is assessed and corrective actions are planned Avoid other aircraft by min of 1000ft in altitude and 1000ft laterally

Physical action(s) required to achieve goal:

Look out
Look at displays
Move aircraft controls to manoeuvre aircraft
Move aircraft throttles to adjust airspeed

Level of precision/accuracy required to perform the preceding action(s):

High

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual

HUD
RDR
AMIRS

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Proximity to other aircraft
Speed
Altitude
Threats
Mission requirements
Number of aircraft in the area
Eyesight
Other taskings (Attention occupied elsewhere)

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 7 1(a) **Goal:** Monitor and Maintain Assigned Radar Sensor Search Parameters **Source Task:** 7 2 7 1(a)

Description:

Confirm that the desired Radar modes and parameters are set for search Monitor radar visually on the DDIs Adjust radar azimuth and elevation search to cover assigned airspace

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, radar displays/controls

Tactical situation, aircraft altitude/speed, mission objectives/requirements, weather, terrain

Number of aircraft in the formation Position in the formation

RDR search area of responsibility

Rdr parameters (Azimuth coverage, elevation coverage, PRF)

Source of information required to achieve goal:

RDR RDR search area of responsibility, Rdr parameters (Azimuth coverage, elevation coverage, PRF)

Link 16/MIDS Tactical situation Number of aircraft in the formation Position in the formation

HUD Tactical situation, aircraft altitude/speed

Visual Tactical situation, aircraft altitude/speed, mission objectives /requirements, weather, terrain Number of aircraft in the formation Position in the formation

Decision(s) required to achieve goal:

Decide to Monitor and Maintain Assigned Radar Sensor Search Parameters

Decide to look at RDR display

Decide to adjust Rdr parameters

Decide to monitor displayed information

Decide that the desired radar modes and parameters are set for search and monitored by visually referencing the radar display on the right DDI

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The level of precision/accuracy in monitoring and maintaining assigned Radar Sensor Search Parameters requires 0 5-2sec every time the parameters are assessed and changed

Physical action(s) required to achieve goal:

Look at RDR display
Look out
Look at displays
Move castle switch to assign TDC
Move TDC to adjust RDR parameters
Move RDR elevation wheel on Hotas
Push display pushbuttons to adjust RDR parameters

Level of precision/accuracy required to perform the preceding action(s):

High

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

RDR

Factor(s) that influence the achievement of the goal:

Altitude
Position in the formation
Threats
Type of mission

CF18 Air to Ground IFP Analysis Results

Range to threats

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 7 1(b) **Goal:** Monitor and Maintain Radar Contact with Formation Members **Source Task:** 7 2 7 1(b)

Description:

To monitor radar contact on formation members, the pilot will visually reference his radar display on his right DDI He will also adjust the settings on his APG 73, most notably the azimuth, PRF, and elevation (using either HOTAS or manual pushbuttons), to allow him to maintain radar contact on friendly formation members

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, radar displays/controls

Tactical situation, phase of mission, mission objectives/requirements

Contact information (bearing,range,altitude,aspect)

Formation members position

Source of information required to achieve goal:

RDR Contact information (bearing,range,altitude,aspect)

Visual Formation members position

Link 16/MIDS· Tactical situation, phase of mission Formation members position

AMIRS Formation members position, Contact information (bearing,aspect)

HUD Formation members position, Contact information (bearing,range, aspect)

Decision(s) required to achieve goal:

Decide to Monitor and Maintain Radar Contact with Formation Members

Decide to look at RDR display

Decide to adjust Rdr parameters

Decide to monitor displayed information

Decide that radar contact on formation members is monitored and maintained by referencing the APG-73 display on the right DDI

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The level of precision/accuracy in monitoring and maintaining Radar contact with Formation Members requires 0 5-2sec every time the position is monitored and assessed

Physical action(s) required to achieve goal:

Look at RDR display
Look out
Look at displays
Move castle switch to assign TDC
Move TDC to adjust RDR parameters
Move RDR elevation wheel on Hotas
Push display pushbuttons to adjust RDR parameters

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning.

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

RDR

Link 16/MIDS

Factor(s) that influence the achievement of the goal:

Altitude
Position in the formation
Threats

CF18 Air to Ground IFP Analysis Results

Type of mission
Range/ azimuth to formation members
Other taskings
Formation members manoeuvres

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 7 1(h) **Goal:** Monitor Tactical Picture on LINK 16/MIDS Displays **Source Task:** 7 2 7.1(h)

Description:

The pilot will visually reference his HSD to monitor the Link 16 display

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, Link 16 displays/controls

Tactical situation, phase of mission, mission objectives/requirements, correlation of displayed information with information displayed from other sources

Friendlies activity and location, Threat activity and location.

Source of information required to achieve goal:

Link 16 MIDS Tactical situation, phase of mission, Friendlies activity and location, Threat activity and location

HUD/RDR/AMIRS/HSD displays correlation of information, Friendlies activity and location, Threat activity and location

Visual Weather, terrain Friendlies activity and location, Threat activity and location.

Decision(s) required to achieve goal:

Decide to monitor target area tactical picture

Decide to adjust the Link16/MIDS display parameters

Decide to look at Link 16/MIDS tactical display

Decide to correlate information with other sources

Decide that the Tactical picture has been built

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Pilot has to analyse displayed information with some accuracy to understand the tactical picture and monitor it The accuracy required depends greatly on the amount of information displayed and the range of coverage

At smaller ranges where all contacts are a factor For 0-1 contacts ~ 0 5-1 sec For 2-3 contacts ~1-2 sec For more than 3 contacts, 1-4sec.

At longer ranges where all contacts are not an immediate factor For 0-1 contacts ~ 0 5 sec For 2-3 contacts 1 sec For more than 3 contacts, 1-3sec.

Physical action(s) required to achieve goal:

Look at Link 16/MIDS display (repeated)

Adjust display parameters via Hotas or pushbuttons

Look at other displays

Level of precision/accuracy required to perform the preceding action(s):

Medium

Pilot has to look at entire picture presented, but also at each detail to build the meaning and understand picture mentally Precision is directly linked to the reasoning.

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

DDI, Link 16 MIDS display Tactical situation / picture

HUD/RDR/AMIRS/HSD displays correlation of information

Factor(s) that influence the achievement of the goal:

Amount of information presented at one time
Complexity of tactical picture

CF18 Air to Ground IFP Analysis Results

Rate of change in situation
Range of contacts
Threats vs friendlies contacts

CF18 Air to Ground IFP Analysis Results

IP Number 7 2 7 2(a) **Goal:** Monitor and Maintain Assigned AMIRS Search Parameters **Source Task:** 7.2.7 2(a)

Description:

The pilot will set his assigned AMIRS search parameters via HOTAS or manual selection. He will monitor and maintain these parameters by visually checking the AMIRS display on the left DDI If they need adjusting, he will accomplish this via HOTAS/manual selection of the AMIRS search parameters on the left DDI

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, AMIRS displays/controls

Tactical situation, aircraft altitude/speed, mission objectives/requirements, atmospheric conditions, terrain, time of day

Number of aircraft in the formation Position in the formation

AMIRS search area of responsibility

AMIRS parameters (Azimuth coverage, elevation coverage)

aircraft altitude/speed

Source of information required to achieve goal:

AMIRS AMIRS displays/controls AMIRS search area of responsibility. AMIRS parameters (Azimuth coverage, elevation coverage)

RDR Tactical situation

Link 16/MIDS: Tactical situation Number of aircraft in the formation. Position in the formation.

HUD Tactical situation, aircraft altitude/speed

Visual Tactical situation, aircraft altitude/speed, mission objectives /requirements, weather, terrain, atmospheric conditions, time of day. Number of aircraft in the formation Position in the formation.

Decision(s) required to achieve goal:

Decide to Monitor and Maintain Assigned AMIRS Sensor Search Parameters

Decide to look at AMIRS display

Decide to adjust AMIRS parameters

Decide to monitor displayed information

Decide that the assigned AMIRS search parameters are set and monitored by visually referencing the AMIRS display on the left DDI

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The level of precision/accuracy in monitoring and maintaining assigned AMIRS Sensor Search Parameters requires 0 5-1sec every time the parameters are assessed and changed

Physical action(s) required to achieve goal:

Look at AMIRS display
Look out
Look at displays
Move castle switch to assign TDC
Move TDC to adjust AMIRS parameters
Push display pushbuttons to adjust AMIRS parameters

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

AMIRS

Factor(s) that influence the achievement of the goal:

Altitude
Position in the formation

CF18 Air to Ground IFP Analysis Results

Threats
Type of mission
Range to threats

CF18 Air to Ground IFP Analysis Results

IP Number 7 2.7 2(b) **Goal:** Monitor and Maintain AMIRS Contact with Formation Members **Source Task:** 7 2 7.2(b)

Description:

To monitor AMIRS contact on formation members, the pilot will visually reference his AMIRS display on his left DDI He will also adjust the settings on his AMIRS, using either HOTAS or manual pushbuttons, to allow him to maintain AMIRS contact on formation members

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, AMIRS displays/controls

Mission objectives/requirements, tactical situation, environmental conditions, time of day,

Contact information (bearing, elevation, range, aspect, altitude).

Formation members position

Source of information required to achieve goal:

AMIRS· Contact information (bearing, elevation), Formation members position

Visual Formation members position

Link 16/MIDS· Tactical situation, phase of mission. Formation members position

RDR· Formation members position, Contact information (bearing, elevation, range, aspect, altitude)

HUD Formation members position, Contact information (bearing, range, aspect)

Decision(s) required to achieve goal:

Decide to Monitor and Maintain AMIRS Contact with Formation Members

Decide to look at AMIRS display

Decide to adjust AMIRS parameters

Decide to monitor displayed information

Decide that AMIRS contact on formation members is displayed and monitored by visually referencing the AMIRS display on the LEFT DDI

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The level of precision/accuracy in monitoring and maintaining AMIRS contact with Formation Members requires 0 5-2sec every time the position is monitored and assessed.

Physical action(s) required to achieve goal:

Look at AMIRS display
Look out
Look at displays
Move castle switch to assign TDC
Move TDC to adjust AMIRS parameters
Push display pushbuttons to adjust AMIRS parameters

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of precision in the physical actions is directly related to the precision/accuracy required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

AMIRS

Factor(s) that influence the achievement of the goal:

Altitude
Position in the formation
Threats
Type of mission
Elevation / Range/ azimuth to formation members
Other taskings

CF18 Air to Ground IFP Analysis Results

Formation members manoeuvres

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CF18 Air to Ground IFP Analysis Results

IP Number 7.2.7.3(a) **Goal:** Maintain Visual Search Patterns **Source Task:** 7.2.7.3(a)

Description:

The pilot will maintain a methodical visual search pattern throughout the entire mission to ensure that no unobserved bogeys/bandits are able to engage his formation without being visually observed

He accomplishes this by developing a scanning pattern that allows him to scan all of the airspace around his aircraft in a deliberate, sequential fashion For example, he may start by observing his deep six o'clock position, then scan out the left side of the canopy until arriving at the 12 o'clock position. He will repeat the same process on the right side of the aircraft, then search the extreme vertical above and below his aircraft This visual search pattern is then repeated throughout the mission

Information required to achieve goal:

Standard operating procedures, visual scan technique.

Mission objectives/requirements, tactical situation, environmental conditions

Aircraft altitude, flight path, speed, environmental conditions

Presence of threats within area of responsibility

Source of information required to achieve goal:

HUD Own Aircraft altitude, flight path, speed

Visual Own Aircraft altitude, flight path, speed, environmental conditions Presence of threats within area of responsibility. Environmental conditions

Link16/MIDS Mission objectives/requirements, tactical situation, Presence of threats within area of responsibility

Decision(s) required to achieve goal:

Decide to Maintain Visual Search Patterns

Decide to actively and methodically scan surroundings

Decide focus distance

Decide on type of scan pattern

Decide on priority and time share in scan pattern

Decide that that no visually unobserved bogeys/bandits are able to engage the formation

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

To maintain visual search patterns, the pilot needs to be methodical and precise to be effective in his approach to scanning the surroundings

The pilot should select the appropriate quadrant to conduct his look out, and alternate between them based on a priority system and a % of importance (varies with the situation)

Focus distance within 5 nm of desired (this precision decreases with range)

The precision/accuracy in attending the goal of Maintaining visual search patterns requires 8-16 sec

The level of precision required each time the pilot looks out to scan one of the quadrants is 2-4 sec

Physical action(s) required to achieve goal:

Look at HUD/displays

Look out by visually scanning the outside world in a pattern that covers area of responsibility, up to 360 degrees

Level of precision/accuracy required to perform the preceding action(s):

Medium

The visual look out follows a preset pattern to be more effective

The precision in the physical actions is directly linked to the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive, Auditory

Source of feedback required to know that goal has been achieved:

Visual

RWR/DEWS

CF18 Air to Ground IFP Analysis Results

Link 16/MIDS

Factor(s) that influence the achievement of the goal:

Environment / Background
Sun's position
Number of aircraft in the formation
Eyesight
Focus distance
Size and aspect of visual contacts
Visual cues from visual contacts (ex : smoke, contrails, movement)
Other taskings
Phase of mission

CF18 Air to Ground IFP Analysis Results

IP Number 7.2 7.3(b) **Goal:** Monitor and Maintain Visual Contact with Formation Members **Source Task:** 7 2 7 3(b)

Description:

The pilot will use normal visual cues to allow him to monitor and maintain visual contact with other formation members

Information required to achieve goal:

Pattern recognition, visual scan technique

Environmental conditions

Mission requirements and objectives. Specifics of the tactical situation (e g threat/friendly forces, weather, terrain, etc).

Formation members range/azimuth , altitude

Relative movement

Source of information required to achieve goal:

HUD. Formation members range/azimuth , altitude

RDR Formation members range/azimuth , altitude

Link 16/MIDS· Specifics of the tactical situation (threat/friendly forces), Formation members range/azimuth , altitude

AMIRS· Formation members range/azimuth ,

Visual weather, terrain, Formation members range/azimuth , altitude Environmental conditions Relative movement

Decision(s) required to achieve goal:

Decide to Monitor and Maintain Visual Contact with Formation Members

Decide confirm formation members position on Displays

Decide to look out

Decide that visual contact with formation members is maintained

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Accuracy/precision while confirming formation members position on the Displays depends on the number of contacts presented at one time For 1 formation member 0 5 sec, for 2- 4 formation members 1 sec, if the display is more complex then 2 sec.

Correlation between information on displays and look out has to be within 10 deg in azimuth and 2 deg in elevation. Focus distance within 2 nm Correlation to the memorized position and/or with sensors should be within 1 nm and 20 deg in azimuth (depending on the number of aircraft in the immediate area)

Physical action(s) required to achieve goal:

Look at displays

Look out

Level of precision/accuracy required to perform the preceding action(s):

Medium

The precision/accuracy required is directly linked to the precision required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual

Link 16/MIDS
RDR
AMIRS

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Eyesight
Visibility
Formation Members position (at expected position?)
Terrain
Distance from contact
Bearing to contact
Threats
Speed
Background
Other taskings
Manoeuvering / Turns

CF18 Air to Ground IFP Analysis Results

IP Number 7.2.7 3(f) **Goal:** Maintain NVG Visual Search Patterns **Source Task:** 7 2 7.3(f)

Description:

The pilot will maintain an NVG visual search pattern throughout all phases of a night mission to ensure that no unobserved bogeys/bandits are able to engage his formation without being visually observed

He accomplishes this by developing a scanning pattern that allows him to scan all of the airspace around his aircraft in a deliberate, sequential fashion. For example, he may start by observing his deep six o'clock position, then scan out the left side of the canopy until arriving at the 12 o'clock position He will repeat the same process on the right side of the aircraft, then search the extreme vertical above and below his aircraft This NVG visual search pattern is then repeated throughout the mission

Information required to achieve goal:

NVG operating procedures, standard operating procedures, visual scan technique with NVGs

Mission objectives/requirements, tactical situation, environmental conditions.

Aircraft altitude, flight path, speed, environmental conditions.

Presence of threats within area of responsibility

Lighting conditions

Source of information required to achieve goal:

HUD· Own Aircraft altitude, flight path, speed

Visual Own Aircraft altitude, flight path, speed, environmental conditions Presence of threats within area of responsibility Environmental conditions Lighting conditions

Link16/MIDS. Mission objectives/requirements, tactical situation, Presence of threats within area of responsibility

Decision(s) required to achieve goal:

Decide to Maintain NVG Visual Search Patterns

Decide to actively and methodically scan surroundings

Decide on type of scan pattern

Decide on priority and time share in scan pattern

Decide that that no visually unobserved bogeys/bandits are able to engage the formation at night

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

To maintain NVG visual search patterns, the pilot needs to be methodical and precise to be effective in his approach to scanning the surroundings

The pilot should select the appropriate quadrant to conduct his look out, and alternate between them based on a priority system and a % of importance (varies with the situation)

The precision/accuracy in attending the goal of Maintaining NVG visual search patterns requires 12-20 sec

The level of precision required each time the pilot looks out to scan one of the quadrants is 3-5 sec

Physical action(s) required to achieve goal:

Look at HUD/displays

Look out by visually scanning the outside world in a pattern that covers area of responsibility, up to 360 degrees

Level of precision/accuracy required to perform the preceding action(s):

Medium

The visual look out follows a preset pattern to be more effective

The precision in the physical actions is directly linked to the reasoning

Type of feedback required to know that goal has been achieved:

Source of feedback required to know that goal has been achieved:

CF18 Air to Ground IFP Analysis Results

Visual, Cognitive	Visual RWR/DEWS Link 16/MIDS RDR AMIRS

Factor(s) that influence the achievement of the goal:

Environment
Lighting intensity (Moon, cities...)
Range
NVG FOV
Number of aircraft in the formation
Eyesight
Size and aspect of visual contacts
Visual cues from visual contacts (ex : movement, lights)

CF18 Air to Ground IFP Analysis Results

IP Number 7.2.7 3(g) **Goal:** Monitor and Maintain NVG Contact with Formation Members **Source Task:** 7.2 7 3(g)

Description:

The NVG-equipped pilot will use normal visual cues to allow him to monitor and maintain visual contact with other formation members In addition, he will use the discreet exterior lighting on other formation member's aircraft to facilitate the visual tracking of his formation aircraft

Information required to achieve goal:

NVG operating procedures, standard operating procedures, visual scan technique with NVGs

Mission objectives/requirements, tactical situation, environmental conditions.

Lighting conditions

Formation members range/azimuth , altitude

Relative movement

Source of information required to achieve goal:

HUD Formation members range/azimuth , altitude

RDR. Formation members range/azimuth , altitude

Link 16/MIDS Specifics of the tactical situation (threat/friendly forces), Formation members range/azimuth , altitude

AMIRS: Formation members range/azimuth ,

Visual. weather, terrain, Formation members range/azimuth , altitude Environmental conditions Relative movement Lighting conditions

Decision(s) required to achieve goal:

Decide to Monitor and Maintain NVG Contact with Formation Members

Decide confirm formation members position on Displays

Decide to look out with NVGs

Decide that visual contact of other formation members will be maintained using NVGs

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Accuracy/precision while confirming formation members position on the Displays depends on the number of contacts presented at one time For 1 formation member 0 5 sec, for 2- 4 formation members 1 sec, if the display is more complex then 2 sec

Correlation between information on displays and look out with NVG has to be within 10 deg in azimuth and 2 deg in elevation Correlation to the memorized position and/or with sensors should be within 1 nm and 20 deg in azimuth (depending on the number of aircraft in the immediate area)

Physical action(s) required to achieve goal:

Look at displays

Look out

Level of precision/accuracy required to perform the preceding action(s):

Medium

The precision/accuracy required is directly linked to the precision required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual

Link 16/MIDS
RDR
AMIRS

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Environment
Lighting intensity (Moon, cities .)
NVG FOV
Size and aspect of visual contacts
Visual cues from visual contacts (ex movement, lights)
Eyesight
Visibility
Formation Members position (at expected position?)
Terrain
Distance from contact
Bearing to contact
Threats
Speed
Background
Other taskings
Manoeuvering / Turns

CF18 Air to Ground IFP Analysis Results

IP Number 7 3.2 2(a) **Goal:** Receive Target Description Brief from FAC **Source Task:** 7 3 2 2(a)

Description:

The formation lead will normally ensure that the appropriate sensors are slaved to the target coordinates before the target description brief from the FAC begins Once ready for the briefing, the FAC will describe the target to the pilots Referring to the target area displayed on the DDIs, the pilots will confirm that the target described matches the image displayed to them

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, CAS specific procedures and tactics, standard communications format, anticipation of IR/radar image of target and target area.

Significant features in target area, target specifics, relative sizes/distances between target and surrounding objects, terrain, environmental conditions

Target position, elevation

Target type

Source of information required to achieve goal:

Visual Significant features in target area, target specifics, relative sizes/distances between target and surrounding objects, terrain, environmental conditions Target type

AMIRS· Significant features in target area, target specifics, relative sizes/distances between target and surrounding objects, terrain, environmental conditions Target position, elevation. Target type

HSD Target position, elevation

HUD Target position, elevation

Decision(s) required to achieve goal:

Decide to receive Target Description Brief from FAC

Decide to slave sensors to the target

Decide to look at the target

Decide to correlate information

Decide that the FAC target description is received and confirmed

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The level of precision/accuracy while receiving the Target Description Brief from FAC requires 2-5 sec

Physical action(s) required to achieve goal:

Look at displays
Look out
Depress pushbutton on HSD to designate target

Level of precision/accuracy required to perform the preceding action(s):

Medium

The precision/accuracy required is directly linked to the precision required in the reasoning.

Type of feedback required to know that goal has been achieved:

Visual, Cognitive , Auditory

Source of feedback required to know that goal has been achieved:

Visual
AMIRS

Factor(s) that influence the achievement of the goal:

Type of target
Distance
Altitude
Environment
Visibility
Threats
Quality of description

CF18 Air to Ground IFP Analysis Results

INS/GPS accuracy
SA
Experience

CF18 Air to Ground IFP Analysis Results

IP Number 7 3 2.2(b) **Goal:** Find Target Using Sensors **Source Task:** 7 3 2 2(b)

Description:

The primary sensors for target detection in the CF-18 are the radar and the AMIRS The radar is used to find targets that are very radar reflective and/or when the weather conditions do not allow the AMIRS to provide an infrared image of the target In nearly all other cases the AMIRS will be the sensor of choice for finding the target

Prior to arriving in the target area, the pilot ensures that the target coordinates are entered correctly into the aircraft database He also confirms the accuracy of his EGI system, and updates the system to improve navigation accuracy, if necessary

As he approaches the target area, the pilot nav designates the target waypoint, slaves the AMIRS to the target designation, and offsets his aircraft slightly to ensure his AMIRS pod has a clear LOS to the target area. Next he optimizes the settings on his AMIRS pod, via HOTAS or manually, to ensure that the best possible IR image is produced In WFOV, the pilot observes the scene on his DDI and compares it with the target imagery and maps provided in mission planning Once satisfied he has the correct target area, he increases the zoom on the AMIRS to ID the target itself With maximum zoom and the range to the target closing, the pilot is provided with a clear, detailed IR image of the target, allowing him to confirm that he has the correct target and, if required, correct any small errors in his designation via the TDC button on the HOTAS

The procedure for finding the target with the radar is very similar, with radar specific information replacing the AMIRS specific details provided above.

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, sensor displays/controls, tactics, anticipation of target representation on display for conditions of the day

General target area features, target specifics,

Range/bearing to the target,

Environmental conditions,

Confirming target ID with maps/imagery,

IR/radar significant features in target area

Source of information required to achieve goal:

AMIRS. General target area features, target specifics, Range/bearing to the target Environmental conditions IR/radar significant features in target area.

Visual General target area features, target specifics, Range/bearing to the target Environmental conditions

RDR General target area features, target specifics, Range/bearing to the target IR/radar significant features in target area

Maps· General target area features, target specifics. Confirming target ID with maps/imagery

HUD Range/bearing to the target

Decision(s) required to achieve goal:

Decide to Find Target Using Sensors

Decide to designate target position

Decide which sensor to use to identify target

Decide to offset aircraft

Decide to optimize sensor image

Decide to increase magnification

Decide to look at specific target features on the displays

Decide that the target is accurately and correctly identified using aircraft sensors

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

From the information provided by intelligence, the pilot has to visualise and memorize the target layout He then has to precisely associate the features presented to him to his memorized image of the target, and then identify the target with high level of confidence (hence high precision) Typically the pilot has to identify 3-4 distinct features in the target, a task that demands between 2-5 sec

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Physical action(s) required to achieve goal:

Look at displays

Look out

Depress pushbutton on HSD to designate target

Move aircraft controls to manoeuvre aircraft

Move castle switch towards selected display

Move/Depress TDC to position cursers to adjust displayed sensor image

Depress DDI pushbutton to adjust displayed sensor image

Move/Depress TDC to adjust sensor designation

Look at displays

Level of precision/accuracy required to perform the preceding action(s):

Medium

The pilot has to fairly accurately look at the information displayed The level of precision/ accuracy is directly linked to the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

AMIRS
RDR
Visual
HUD

Factor(s) that influence the achievement of the goal:

Target area significant features
Sensor representation of the significant features
Familiarity with type of sensor display image
Time of day
Reflectivity
Contrast with surroundings
Range / Magnification
Environmental factors and effects on sensor

CF18 Air to Ground IFP Analysis Results

IP Number 7 3 2 2(d) **Goal:** Communicate Target Acquired **Source Task:** 7 3 2 2(d)

Description:

The pilot communicates that he has acquired the target using secure voice on Have Quick II and/or via Link 16

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, standard communications format

Tactical situation, quality/security of communications

That the frequency is free/not being used

Source of information required to achieve goal:

Headphones· That the frequency is free/not being used.

UFC That the proper frequency net is dialed

AMIRS/RDR/Visual Target description

Link 16/MIDS Target description

Decision(s) required to achieve goal:

Decide to Communicate Target Acquired

Decide to communicate on HQ II Secure comms/ datalink

Decide that the frequency net is free

Decide to transmit on the frequency net

Decide to type information via datalink

Decide that it is clearly communicated that the target has been acquired

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The pilot has to clearly think and formulate his communication before he transmits, usually following standard terminology The level of precision/ accuracy is between 1-2 sec while attending the goal of communicating target acquired on Have Quick II or via data link

Physical action(s) required to achieve goal:

Look at UFC

Look at displays

look out

Listen on the frequency

Depress the comm 1/2 switch with left thumb

Speak in the microphone

Level of precision/accuracy required to perform the preceding action(s):

Medium

Accuracy is required while speaking on the radio and is directly related to the precision required in the reasoning

Type of feedback required to know that goal has been achieved:

Auditory, Visual, Cognitive

Source of feedback required to know that goal has been achieved:

UFC

Headphones
AMIRS/RDR/Visual

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Distance from FAC
Comm Jamming
Quality / condition of microphone
Amount of g while communicating
Target complexity
Proximity to similar targets
Threats

CF18 Air to Ground IFP Analysis Results

IP Number 7.3 2.2(c) **Goal:** Describe Target Area and Target to FAC **Source Task:** 7 3 2 2(c)

Description:

The pilot describes the target area and target to the FAC using Have Quick II The description normally begins with an overview of where, from the pilot's perspective, the tarot lies relative large geographic features nearby The use of cardinal headings is used when describing objects location relative one another in order to avoid confusion The pilot then gives a detailed description of the target's appearance, location, and any unique identifying traits that give the FAC confidence the pilot has acquired the correct target The FAC and pilot, still using have Quick II, will normally confirm a few more details as a final confirmation that the proper target is about to be attacked

Information required to achieve goal:

Standard operating procedures, standard communications format, sensor displayed target information

Target specifics and description, target area layout, location of target relative other significant objects in target area, environmental conditions, tactical situation, quality/security of communications

Target description

Source of information required to achieve goal:

Headphones That the frequency is free/not being used

UFC That the proper frequency net is dialed

AMIRS/RDR/Visual Target description, Target specifics and description, target area layout, location of target relative other significant objects in target area

Link 16/MIDS Target description, tactical situation,

Decision(s) required to achieve goal:

Decide to Describe Target Area and Target to FAC

Decide to communicate on HQ II Secure comms/ datalink

Decide what target information to communicate

Decide that the frequency net is free

Decide to transmit on the frequency net

Decide to type information via datalink

Decide that the FAC has received a target and target area description

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The pilot has to clearly describe the target to the FAC Typically 3-4 features have to be precisely described to confirm target

Physical action(s) required to achieve goal:

Look at UFC

Look at displays

look out

Listen on the frequency

Depress the comm 1/2 switch with left thumb

Speak in the microphone

Level of precision/accuracy required to perform the preceding action(s):

Medium

Accuracy is required while speaking on the radio and is directly related to the precision required in the reasoning

Type of feedback required to know that goal has been achieved:

Source of feedback required to know that goal has been achieved:

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Auditory, Visual, Cognitive	UFC Headphones AMIRS/RDR/Visual

Factor(s) that influence the achievement of the goal:

Distance from FAC
Comm Jamming
Quality / condition of microphone
Amount of g while communicating
Target complexity
Proximity to similar targets
Threats

CF18 Air to Ground IFP Analysis Results

IP Number 7.3.2.2(h) **Goal:** Find Target with NVG **Source Task:** 7.3.2.2(h)

Description:

Prior to arriving in the target area, the pilot ensures that the target coordinates are entered correctly into the aircraft database He also confirms the accuracy of his EGI system, and performs an update to improve navigation accuracy, if necessary

The NVG equipped pilot will find his target in much the same way a pilot finds his target visually during the daytime. This will involve performing some form of dive manoeuvre in order to visually acquire the target using his NVGs at night. Prior to performing the dive attack, the pilot normally nav designates the target He then offsets the target to either the left or right and then, at a pre-calculated distance/altitude/speed, he executes the dive manoeuvre. This brings the target designation alive in his HUD, allowing him to scan the area around the target designation with his NVGs Once satisfied that he has the proper target, he fine tunes his target designation if required, and then pulls out of his dive, never lower than a pre-briefed minimum altitude

Information required to achieve goal:

NVG search pattern technique, pattern recognition, key features to find ground patterns visually.

Significant features in target area that help positively ID target, unique target features, (e g terrain, large features surrounding Target, smaller unique target features)

Target area environmental conditions and light conditions

Aircraft position, altitude, speed, heading, ground track

Aircraft target designation

Distance from target, attack run in direction, target elevation, anticipated distance from the target where line of sight is possible

Source of information required to achieve goal:

HUD: Aircraft position, altitude, speed, heading, ground track, Distance from target, Aircraft target designation

HSD: Aircraft position, ground track, distance from target, attack run in direction, Aircraft target designation

AMIRS Significant features in target area that help positively ID target, unique target features, (e.g terrain, large features surrounding Target, smaller unique target features) Aircraft target designation

NVG/Visually Significant features in target area that help positively ID target, unique target features, (e g terrain, large features surrounding Target, smaller unique target features) Attack run in direction, target elevation, anticipated distance from the target where line of sight is possible

Decision(s) required to achieve goal:

Decide to Find Target with NVG

Decide to look at target designation

Decide to look at displays

Decide to search for target with NVG/visually

Decide to identify specific target features

Decide that the target is visually acquired using NVGs

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

From the information provided by intelligence, the pilot has to visualise and memorize the target layout He then has to precisely associate the features presented to him to his memorized image of the target, and then identify the target with high level of confidence (hence high precision) Typically the pilot has to identify 3-4 distinct features in the target, a task that demands between 2-5 sec

Physical action(s) required to achieve goal:

Look at displays

Move aircraft controls to manoeuvre aircraft

Look out with NVG

Level of precision/accuracy required to perform the preceding action(s):

Medium

Accuracy is required while speaking on the radio and is directly related to the precision required in the reasoning

Type of feedback required to know that goal has been achieved:

Source of feedback required to know that goal has been achieved:

CF18 Air to Ground IFP Analysis Results

Visual, Cognitive	Visual HUD AMIRS RDR

Factor(s) that influence the achievement of the goal:

Target type, size, shape, camouflage
Target surroundings
Aircraft altitude and speed
Eyesight
Light condition (DAY/NIGHT/DUSK ..)
Crosscheck effectiveness (can the pilot effectively split his attention between Flying the aircraft and searching the target)
Threats

CF18 Air to Ground IFP Analysis Results

IP Number 7.3.3 2(h) **Goal:** Conduct Self-Lasing LGB Delivery **Source Task:** 7 2 2 2(h)

Description:

Once PGM weapon is released, ensure that the Laser is armed and ready to fire For auto delivery, confirm that the laser is being fired at the target at the appropriate times. Monitor LGB impact For continuous lasing delivery, enable the trigger option by depressing the appropriate pushbutton on the AMIRS display Fire the laser manually after bomb release by depressing the trigger on the control stick Monitor LGB impact Once weapon has impacted the target, release the trigger.

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, target/target area information, weaponeering information

Tactics Weapons operating procedures.

Weather conditions, visibility, winds, sun, terrain, target type

Type of weapon released

Weapon release command received by aircraft

Transition to Laser countdown

Laser status

Time to impact

Source of information required to achieve goal:

HUD Type of weapons released, Weapon release command received by aircraft Time to impact

AMIRS· Weather conditions, visibility, sun, terrain, target type. Transition to Laser countdown Laser status. Time to impact

Visual Weather conditions, visibility, winds, sun, terrain, target type

Decision(s) required to achieve goal:

Decide to Conduct Self-Lasing LGB Delivery

Decide to confirm laser status

Decide to monitor time to impact

Decide to use manual lasing

Decide that the self-lasing LGB delivery is conducted safely and effectively

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

While the laser is being fired, the designation has to be maintained accurately on the target, center of the TD diamond (aiming point) within 2 mm of desired DMPI

Physical action(s) required to achieve goal:

Look out
Look at HUD
Look at AMIRS display
Move TDC to update designation

Depress trigger option on AMIRS display
Depress trigger
Release trigger

Level of precision/accuracy required to perform the preceding action(s):

High

Accuracy is required while speaking on the radio and is directly related to the precision required in the reasoning

Type of feedback required to know that goal has been achieved:

Source of feedback required to know that goal has been achieved:

Visual, Cognitive	AMIRS HUD Visual

Factor(s) that influence the achievement of the goal:

Type of weapon released
Delivery window (time)
Environmental conditions
Altitude
Terrain avoidance
Threats
Podium effect

CF18 Air to Ground IFP Analysis Results

IP Number 7.3.4 1(b) **Goal:** Confirm Formation Position on LINK 16/MIDS Tactical Displays **Source Task:** 7 1 1 3(d)

Description:

Adjust and/or confirm LINK 16/MIDS Tactical Display parameters to ensure the desired airspace is covered Reduce range scale to ensure clarity of displayed information. Observe picture being built on the LINK 16/MIDS Tactical Display. Visually confirm position of Formation members by analyzing displayed information Mentally build formation position and situational awareness.

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, Link 16 displays/controls.

Tactical situation, phase of mission, mission objectives/requirements, correlation of displayed information with information displayed from other sources

Range scale, Reference point (own aircraft, bull eye, designated point), formation members position/altitude/ velocity (speed/direction) in relation to that reference point

Source of information required to achieve goal:

Link 16/MIDS display. Tactical situation, Range scale, Reference point (own aircraft, bull eye, designated point), formation members position/ altitude/ velocity (speed/direction) in relation to that reference point

RDR/AMIRS/IFF interrogator/HSD· correlation of displayed information with information displayed from other sources

Decision(s) required to achieve goal:

Decide to look at the display

Decide to adjust display parameters

Decide to confirm information with other sources

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

In order to confirm the formation member's position, the pilot has to process the information displayed with some accuracy to build a mental picture of the situation

The precision/accuracy required while attending the goal of confirming formation position on the Link16/MIDS is between 1-3sec.

Physical action(s) required to achieve goal:

Look at Link 16/MIDS display

Adjust display parameters (if required) by Hotas and/or pushbuttons on DDI.

Level of precision/accuracy required to perform the preceding action(s):

Medium

In order to adjust the display parameters via Hotas, the pilot has to be fairly precise with the TDC actions (left index finger), to place the cursers within 1 cm of the desired position

Type of feedback required to know that goal has been achieved:

Visual, cognitive

Source of feedback required to know that goal has been achieved:

Link 16/MIDS display
Visual Confirmation
RDR/AMIRS/IFF interrogator/HSD confirmation

Factor(s) that influence the achievement of the goal:

Number of aircraft in the formation
Position of formation members (In briefed position or not)
Altitude and Altitude delta
Proximity to other formation members
Type of formation
Phase of mission (ex rejoining after target attack)

CF18 Air to Ground IFP Analysis Results

IP Number 7 3 4 1(c) **Goal:** Conduct Formation Join-up **Source Task:** 7 1 1 3(c)

Description:

Formation Join-up is performed by using a combination of a visual overtake and cut-off angle

The cut-off angle is maintained by varying bank angle as the aircraft is moving up the reference line The geometry of the rejoin is such that an increase in speed will require a decrease in bank to maintain the cut-off angle and vice versa Radar lock-on may be used to assist The Vc is monitored on the HUD and represent your true closure (both longitudinal and lateral)

Establish a crosscheck between speed, bank angle and the reference line. The closure is then reduced as the desired formation position is attained.

To rejoin in close formation, the aircraft is moved to one side about 2-3 aircraft widths and about 50 feet low. 50 to 100 kts of closure is then established initially Reduce closure rate as the range decreases Fifty KIAS closure at 3,000' is a good rule of thumb

Information required to achieve goal:

Standard operating procedures, aircraft controls and throttles, mission briefing

Environmental conditions, relative formation following attack phase, surface-to-air and air-to-air threats in near proximity, timing/routing constraints

Formation Members position, airspeed, heading, altitude

Bearing/ range to formation member

Closure

Cut off angle

Own Aircraft altitude, heading, attitude, speed, g

Source of information required to achieve goal:

Visual Formation Members position, airspeed, heading, altitude, Formation Members position, airspeed, heading, altitude, Closure, Cut off angle

HUD. Formation Members position, heading, altitude, Closure, Cut off angle

RDR Formation Members position, airspeed, heading, altitude, Bearing/ range to formation member, Closure, Cut off angle

AMIRS Formation Members position, Bearing/ range to formation member

Link 16/MIDS: Formation Members position, heading, altitude, Bearing/ range to formation member, Cut off angle

HSD Formation Members position, heading, Bearing/ range to formation member, Cut off angle

Decision(s) required to achieve goal:

Decide to conduct formation join up

Decide to look at displays

Decide to look out

Decide to establish cut off angle

Decide to use overtake / establish closure

Decide to cross check information on displays

Decide to adjust cut off angle and closure

Decide to reduce closure

Decide to rejoin to close formation

Decide to move up the reference line

Decide to adjust bank angle and closure

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The level of precision/accuracy in the closure should be within 30kts for a tactical rejoin and within 10 kts for the close formation rejoin The cut off angle within 30 deg of desired for tactical rejoin and 10 deg for the close formation rejoin

CF18 Air to Ground IFP Analysis Results

Decide that the aircraft has rejoined to tactical / close formation

Physical action(s) required to achieve goal:

Look at displays (repeated)
Look out (repeated)
Look at HUD (repeated)
Move stick to roll Aircraft (repeated)
Move throttles to adjust airspeed (repeated)
Pull back on stick to apply g (repeated)
Move stick to adjust flight path (repeated)

Level of precision/accuracy required to perform the preceding action(s):

Medium

The tactical rejoin requires aggressive movements with some precision to achieve the goal

The Close formation rejoin requires a higher level of precision in the physical actions due to the proximity of the other Aircraft

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual
HUD
RDR display
Link 16/MIDS
HSD

Factor(s) that influence the achievement of the goal:

Distance from formation member
Airspeed
Altitude
Energy delta from lead
Threats
Visibility
Eyesight
Tactical rejoin vs Close Formation rejoin
Type of formation to rejoin to
Background
Aggressiveness

CF18 Air to Ground IFP Analysis Results

IP Number 7.3.4.1(c) **Goal:** Establish NVG Contact with Other Formation Members **Source Task:** 7.1.1.2(h)

Description:

From SA built with Aircraft sensors and LINK 16/MIDS, look in the estimated bearing and range of the mission elements. Start a visual search pattern at the estimated location of the contacts. Find mission elements visually with NVG.

Information required to achieve goal:

Visual/NVG scan techniques, standard operating procedures, NVG operating procedures.

Mission requirements and objectives. Specifics of the tactical situation (e.g. threat/friendly forces, weather, terrain, etc.)

Environmental conditions

Formation members range/azimuth , altitude

Lighting conditions

Source of information required to achieve goal:

HUD. Formation members range/azimuth , altitude

RDR. Formation members range/azimuth , altitude

Link 16/MIDS. Specifics of the tactical situation (threat/friendly forces), Formation members range/azimuth , altitude

AMIRS. Formation members range/azimuth ,

NVG/Visual. weather, terrain, Formation members range/azimuth , altitude. Environmental conditions
Lighting conditions

Decision(s) required to achieve goal:

Decide to Establish NVG Contact with Other Formation Members

Decide to find formation members position on Displays

Decide to look out with NVGs

Decide to establish search pattern

Decide that visual contact with other formation members is established using NVGs

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Accuracy/precision while finding formation members on the Displays depends on the number of contacts presented at one time. For 1 formation member 0.5 sec, for 2- 4 formation members 1-2 sec, if the display is more complex then 2-3 sec

Correlation between information on displays and look out has to be within 10 deg in azimuth and 5 deg in elevation. The NVG visual search pattern should cover enough area while remaining concentrated around expected position (within 20 deg and 5 nm). Once the formation member has been found, correlation to the memorized position and/or with sensors should be within 1 nm and 20 deg in azimuth (depending on the number of aircraft in the immediate area).

Physical action(s) required to achieve goal:

Look at displays

Look out

Level of precision/accuracy required to perform the preceding action(s):

Medium

The precision/accuracy required is directly linked to the precision required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

HUD
RDR
Link 16/ MIDS
AMIRS
Visual

CF18 Air to Ground IFP Analysis Results

Factor(s) that influence the achievement of the goal:

Eyesight
Visibility
Formation Members position (at expected position?)
Terrain
Distance from contact
Bearing to contact
Threats
Speed
Background
Environment
Lighting intensity (Moon, cities...)
NVG FOV
Number of aircraft in the formation
Size and aspect of visual contacts
Visual cues from visual contacts (ex · movement, lights)

CF18 Air to Ground IFP Analysis Results

IP Number 7 3 4 2(f) **Goal:** Adjust to Medium/High Altitude (Permissive Environment) **Source Task:** 7 2 1 1(e)

Description:

Establish in a climb/descent while maintaining required ground speed Cross check altitude by visually confirming Barometric Altitude in the HUD Level Off at the desired altitude Cross check that the chosen altitude is at least 1000' above or below TLs

Information required to achieve goal:

Aircraft operating instructions, standard operating procedures, tactics, formation keeping procedures

Tactical scenario, mission objectives/requirements

Environmental conditions

Aircraft altitude, flight path, ground speed, heading, position

Threats

Source of information required to achieve goal:

HUD Aircraft altitude, flight path, speed, heading, position Threats

HSD Aircraft heading, position, ground speed Threats

Link 16/MIDS. Aircraft position, Tactical scenario, mission objectives /requirements Threats

Visual Environmental conditions Aircraft altitude, flight path, speed, heading, position Threats

Decision(s) required to achieve goal:

Decide to Adjust to Medium/High Altitude (Permissive Environment)

Decide to look at displays

Decide to look out

Decide to change altitude

Decide to level off

Decide that the formation successfully adjusts to medium/high altitude during the egress

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The level of accuracy required when adjusting to Medium/High altitude requires generally that the pilot maintain altitude within 200 ft of desired (On ACO/ACM)

Maintain ground speed within 20 kts of desired

Physical action(s) required to achieve goal:

Look out
Look at displays
Move stick to manoeuvre aircraft
Pull back on stick to set desired climb angle
Move throttles to adjust airspeed
Push on stick to level off

Level of precision/accuracy required to perform the preceding action(s):

Medium

The precision/accuracy required is directly linked to the precision required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

HUD
HSD

Factor(s) that influence the achievement of the goal:

Threats
Fuel

CF18 Air to Ground IFP Analysis Results

Scenario
ACO/ACM
Weather

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 1 1(a) **Goal:** Employ Radar Search Sort and Target Contract **Source Task:** 7 5 2 2(a)

Description:

The formation members will scan their assigned radar search volume They will call out all detected targets within their search volume to other formation members via Have Quick II/Link 16 The formation lead will assign targeting responsibilities if multiple groups are present At the roll range, formation members will meld their radars to their assigned group and begin to sort. Narrowing down their radar scan volume, and using a different radar mode optimized for sorting multiple contacts (I e TWS), the formation members study their radar display As the radar breaks out the multiple targets in the group, each pilot commands a lock on his target The formation members then call the status of their sort, and then continue the remainder of the intercept as per lead's direction or the mission briefing

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics. APG -73 Radar operating procedures

Mission objectives/requirements, tactical situation, environmental conditions

Own Aircraft altitude, speed, heading

Radar search volume, Radar parameters, Radar modes

IFF interrogation results

Enemy contacts position, bull eye position, numbers, altitude, heading, speed, relationship between contacts, distance between contacts, enemy contacts manoeuvering/evading manoeuvres, contacts azimuth and elevation

Source of information required to achieve goal:

RDR: tactical situation, Radar search volume, Radar parameters, Radar modes IFF interrogation results Enemy contacts position, bull eye position, numbers, altitude, heading, speed, relationship between contacts, distance between contacts, enemy contacts manoeuvering/evading manoeuvres, contacts azimuth and elevation

Link 16/MIDS tactical situation, IFF interrogation results.

HUD tactical situation, Own Aircraft altitude, speed, heading IFF interrogation results

Visual tactical situation, Own Aircraft altitude, speed, heading

Decision(s) required to achieve goal:

Decide to employ Radar Search

Decide to look at displays

Decide to set the desired Search volume

Decide to set Radar parameters

Decide to roll search volume

Decide to employ Radar Sort

Decide to narrow down Radar Scan volume

Decide to switch Radar modes

Decide to specifically look at group/contact responsibility

Decide to Target specific contact

Decide that the desired contact has been targeted / locked

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The precision required to employ Radar search is approximately 1-2sec every time the pilot looks at the display For Radar Sort 2-4sec, and to achieve targeting / lock 3-5sec

CF18 Air to Ground IFP Analysis Results

Physical action(s) required to achieve goal:

Look at RDR display (Repeated)
Move TDC to adjust Radar search volume
-or-Depress pushbuttons on the DDI to adjust Radar search volume
Roll elevation switch on HOTAS to adjust Radar elevation volume
Move TDC to set Radar parameters
-or-Depress pushbuttons on the DDI to set Radar parameters

Roll elevation switch on HOTAS to adjust Radar elevation volume
Move TDC to adjust Radar search volume
-or-Depress pushbuttons on the DDI to adjust Radar search volume
Move TDC to change Radar Mode
-or-Depress pushbuttons on the DDI to change Radar Mode

Move TDC to position cursers over contact
Depress on the TDC to command lock (if required)
-or-Move castle switch right to command lock (if required)

Level of precision/accuracy required to perform the preceding action(s):

High

When setting Radar parameters, the precision required while moving the TDC is ~1 cm For the purpose of moving cursers on the Radar display while searching and sorting, precision of 0.5 cm, and for targeting/locking desired contact, 0.25 cm.

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

RDR

Link 16/MIDS
HUD
Visual
HSD

Factor(s) that influence the achievement of the goal:

Range
Contacts Aspect/ closure
Contacts proximity
Number of contacts
Altitude
Look up vs look down
Azimuth (close to gimbals limits)
SA
Radar parameters chosen
Coverage (Is the desired airspace covered)

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 1 1(g) **Goal:** Acquire Enemy Contacts on LINK 16/MIDS Displays **Source Task:** 7 5 2 2(g)

Description:

Acquiring enemy contacts on the Link 16 display involves interpreting the link 16 information displayed on the HSD Contacts that have been positively identified as enemy, will normally be colored red. This enemy contact information can then be passed from the Link 16 to one of the on-board targeting sensors (I e the AMIRS or Radar), or used to carry-out a visual acquisition of the contacts (employing NVGs if conducting night operations)

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures Link 16 displays/controls

Tactical situation, phase of mission, mission objectives/requirements, correlation of displayed information with information displayed from other sources

Range scale, Reference point (own aircraft, bull eye, designated point), enemy contacts position/altitude/ heading, relationship between contacts (Type of formation)

IFF interrogation results

Source of information required to achieve goal:

Link 16/MIDS Tactical situation, Range scale, Reference point (own aircraft, bull eye, designated point), enemy contacts position/altitude/ heading, relationship between contacts (Type of formation) IFF interrogation results

HUD Tactical situation, IFF interrogation results

HSD Tactical situation, Range scale, Reference point (own aircraft, bull eye, designated point), enemy contacts position/altitude/ heading, relationship between contacts (Type of formation). IFF interrogation results

RDR Tactical situation, Range scale, Reference point (own aircraft, bull eye, designated point), enemy contacts position/altitude/ heading, relationship between contacts (Type of formation) IFF interrogation results

AMIRS Tactical situation, Range scale, Reference point (own aircraft, bull eye, designated point), enemy contacts position, relationship between contacts (Type of formation)

Visual Tactical situation,

Decision(s) required to achieve goal:

Decide to acquire enemy contacts on Link 16/MIDS

Decide to look at displays

Decide to adjust Link 16/MIDS display parameters

Decide to specifically find enemy contacts on the Link 16/MIDS display

Decide to correlate that information with other displays

Decide that the enemy contacts have been acquired

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

In order to acquire enemy contacts on the Link 16/MIDS displays, the pilot has to process the information displayed with some accuracy to build a mental picture of the situation

The precision/accuracy required while attending the goal of acquiring enemy contacts on the Link16/MIDS is between 2-4sec

Physical action(s) required to achieve goal:

Look at Link 16/MIDS display

Adjust display parameters (if required) by Hotas and/or pushbuttons on DDI

Level of precision/accuracy required to perform the preceding action(s):

Medium

In order to adjust the display parameters via Hotas, the pilot has to be fairly precise with the TDC actions (left index finger), to place the cursers within 1 cm of the desired position

Type of feedback required to know that goal has been achieved:

Source of feedback required to know that goal has been achieved:

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CF18 Air to Ground IFP Analysis Results

Visual, Cognitive	Link 16/MIDS display Visual Confirmation RDR/AMIRS/IFF interrogator/HSD confirmation

Factor(s) that influence the achievement of the goal:

Number of aircraft in the formation
Position of formation members (In briefed position or not)
Altitude and Altitude delta
Proximity to other formation members
Type of formation
Phase of mission (ex rejoining after target attack)

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 1 1(m) **Goal:** Interrogate Unknown Radar Contacts with IFF **Source Task:** 7 2 7 1(g)

Description:

The pilot will slave the IFF to the targets being tracked by the APG 73 Then, using HOTAS, he will command the IFF to interrogate the unknown radar contacts He will monitor the interrogation results on his radar display. Once the contacts have been interrogated, he will pass the results of the IFF interrogation via secure voice or Link 16 or both.

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics, IFF interrogator operating procedures

Mission objectives/requirements ROE. Tactical situation

Position of Radar contact to be interrogated.

Correlation of IFF information with other tactical information displayed

Source of information required to achieve goal:

RDR. Tactical situation. Position of Radar contact to be interrogated Correlation of IFF information with other tactical information displayed.

Link 16/MIDS Tactical situation. Position of contact to be interrogated Correlation of IFF information with other tactical information displayed

HSD. Position of contact to be interrogated. Correlation of IFF information with other tactical information displayed

HUD Position of contact to be interrogated Correlation of IFF information with other tactical information displayed

Visual Position of contact to be interrogated

Decision(s) required to achieve goal:

Decide to interrogate unknown radar contacts with IFF

Decide to look at displays

Decide to slave the cursers over specific contact

Decide to interrogate specific radar contact with IFF

Decide that the IFF interrogation has been completed

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Some precision/accuracy required in the sequence of events to be carried out Level of precision required while performing IFF interrogation is 2-5 sec

Physical action(s) required to achieve goal:

Look at displays

Move TDC to move RDR cursers

Depress IFF Interrogation button on HOTAS

Look at RDR display

Communicate results (if required)

Level of precision/accuracy required to perform the preceding action(s):

High

High precision required when placing the cursers over the specific Radar contact, cursers to be positioned within 0.5 cm.

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

RDR display

Factor(s) that influence the achievement of the goal:

CF18 Air to Ground IFP Analysis Results

Number of contacts in close proximity
Altitude, terrain masking
Friendlies in the Area (possibly not displaying proper IFF codes)
SA

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 1 1(n) **Goal:** Employ Have Quick II Secure Communications **Source Task:** 7 4 2 2(b)

Description:

The pilot reports the target via secure voice transmission when using Have Quick II The transmission is sent using Comm 1 or 2 (whichever one is configured for Have Quick II transmission)

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, standard communications format/procedures Systems knowledge (HQ II)

Mission objectives/requirements, tactical situation, environmental conditions, radio range/line-of-sight limitations, complex comm jamming encountered

Have quick II preset frequency nets being used

Information to be passed on, External cues

That the frequency is free/not being used

That the proper frequency net is dialed

Source of information required to achieve goal:

Headphones: That the frequency is free/not being used.

UFC That the proper frequency net is dialed

Decision(s) required to achieve goal:

Decide to communicate on HQ II Secure comms.

Decide what information to communicate

Decide what frequency net/radio to communicate on

Decide that the frequency net is free.

Decide to transmit on the frequency net

Decide that the information has been communicated

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The pilot has to clearly think and formulate his communication before he transmits, usually following standard terminology The level of precision/ accuracy is between 2-5 sec while attending the goal of communicating on Have Quick II

Physical action(s) required to achieve goal:

Look at UFC

Select desired frequency net (if required) by pulling/turning the preset buttons, or by typing in the frequency net desired on the UFC.

Listen on the frequency

Depress the comm 1/2 switch with left thumb

Speak in the microphone

Level of precision/accuracy required to perform the preceding action(s):

Medium

The precision/accuracy in the physical actions is required while selecting the frequency net When the desired frequency net has to be selected via presets, a precision of +/- 0, or via selecting the frequency net manually, again requiring a precision of +/- 0

The accuracy while depressing the comm 1/2 button is required to ensure that the desired radio is used, therefore a precision of ~ 1 cm while depressing the comm 2 switch

Accuracy is required while speaking on the radio and is directly related to the precision required in the reasoning

CF18 Air to Ground IFP Analysis Results

Type of feedback required to know that goal has been achieved:	Source of feedback required to know that goal has been achieved:
Auditory, Visual, Cognitive	UFC Headphones

Factor(s) that influence the achievement of the goal:

Distance from formation members
Quantity of communication on the frequency
Comm Jamming
Quality / condition of microphone
Amount of g while communicating
Stress / Excitement
Accuracy of net frequencies
Synchronization of frequencies

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 2 2(c) **Goal:** Employ Jammers **Source Task:** 7.5.2.3(c)

Description:

The Jammers generally function automatically The pilot can optimize Jammers employment by analyzing their coverage on the Integrated HSD display, ensuring that the intended enemy threats are within the displayed Jammers coverage If the enemy threats are outside the displayed Area, the pilot will manoeuvre the aircraft to place the threats within coverage

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics, enemy tactics, enemy electronic order of battle

Mission objectives/requirements, tactical situation.

Aircraft altitude/flight path/speed, environmental conditions.

Jammer coverage, Threat position

Decision(s) required to achieve goal:

Decide to employ jammers

Decide to find out if threats fall into jammer coverage

Decide to manoeuvre aircraft to place threats into jammer coverage

Decide that the jammer are being effectively employed

Physical action(s) required to achieve goal:

Look at displays

Look out

Look at jammer lights

Move stick to manoeuvre aircraft

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Factor(s) that influence the achievement of the goal:

Jammer effectiveness close to the displayed boundary envelope
Number of threats
Terrain

Source of information required to achieve goal:

HUD Aircraft altitude/flight path/speed

Visual· Aircraft altitude/flight path/speed, environmental conditions,

HSD· tactical situation, Jammer coverage, Threat position

Link 16/MIDS· tactical situation, Jammer coverage, Threat position

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The level of accuracy/precision in the assessment of threats vs jammer coverage should be within ~ 10 deg in azimuth and ~ 3 nm in range of the displayed jammer coverage

Level of precision/accuracy required to perform the preceding action(s):

Medium

The precision/ accuracy of the analysis of the displayed information on the HSD will required approximately 1sec of attending

The aircraft should be manoeuvre at a precision to put the threats within jammer coverage, within 5 deg of the displayed boundary

The level of precision in attending to the jammer lights is Low, 0 25-0 5 sec

Source of feedback required to know that goal has been achieved:

HSD
Visual
Link 16/MIDS
Jammer lights

CF18 Air to Ground IFP Analysis Results

Speed of threats
SA

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 2 3(c) **Goal:** Negate Enemy Air Weapons Employment **Source Task:** 7 5 2 4(c)

Description:

The pilots will Negate Enemy Air Weapons Employment by manoeuvring and remaining outside enemy air weapons effective range and by employing DEWS

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics, enemy tactics, enemy order of battle, enemy weapons, effective actions to defeat enemy weapons

Aircraft altitude/flight path/speed/ heading,

Environmental conditions

Enemy type/range/altitude/position/ heading Type of weapon employed

Source of information required to achieve goal:

RWR Enemy position (bearing) Type of weapon employed Enemy Radar effectiveness in tracking own aircraft

Audio Enemy Radar effectiveness in tracking own aircraft

DDI (Link 16/MIDS/ RDR) Enemy type/range/altitude/position/ heading , Location of formation members

HSD Enemy range/position, Own Aircraft position, Enemy Radar effectiveness in tracking own aircraft

HUD Own Aircraft position, altitude, attitude, heading, speed and g, Enemy Radar effectiveness in tracking own aircraft

Look out Own Aircraft position, altitude, attitude, heading, environmental conditions Enemy position / enemy weapons employed and effectiveness

Seat of the pants attitude, heading, speed and g

Decision(s) required to achieve goal:

Decide for appropriate time / range to execute manoeuvre

Decide appropriate direction of manoeuvre

Decide to start manoeuvre

Decide to employ Chaff

Decide to roll out on appropriate heading

Decide to set appropriate flight path

Decide to update direction as required

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

To achieve effectiveness in negating Enemy Air Employment, the pilot needs to analyse all inputs relatively fast and accurately The decisions required need to be fairly precise in timing and direction

Physical action(s) required to achieve goal:

Look at displayed information to assess situation

Look out to assess environment / formation position / flow

Turn A/C in desired direction by turning stick

Level of precision/accuracy required to perform the preceding action(s):

Power setting within appropriate range (MAX, Mil, Sub MIL, Idle)
Pull g @ +/- 2 g
Dispense Chaff at appropriate time +/- 10 sec
Roll out and update heading to +/- 20 deg
Set flight path +/- 20 deg

CF18 Air to Ground IFP Analysis Results

Select high power setting

Pull High G by pulling stick back

Dispense Chaff program

Roll out on appropriate heading

Set desired flight path

Look at displays / look out (repeated)

Turn to updated heading (repeated)

Dispense Chaff (repeated)

Type of feedback required to know that goal has been achieved:

Visual, cognitive

Source of feedback required to know that goal has been achieved:

RWR
Audio feedback from RWR
RDR/MIDS display
Visual lookout

Factor(s) that influence the achievement of the goal:

Turn at high sustained G
Sometimes required to change direction with large heading changes (notch / pump / abort), which can be disorientating and add difficulty in keeping SA

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 2 4(c) **Goal:** Employ Air-to-Air RMD **Source Task:** 7 5 2 5(c)

Description:

The Air-to-Air RMD is initially performed by an aggressive manoeuvre into the Notch (at 90 degrees from incoming enemy radar) while employing Chaff Manoeuvre the aircraft downwards to ensure that enemy radar will be looking through ground clutter Update heading to maintain the Notch by assessing DEWS displayed information At the appropriate range, transition into IRMD

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics, enemy tactics, enemy order of battle, enemy weapons, effective actions to defeat enemy weapons

Aircraft altitude/flight path/speed/heading, environmental conditions Enemy type/range/altitude/position Type of weapon employed. Enemy Radar effectiveness in tracking own aircraft.

Route/flow to target

Location of other threats

Location of formation members

Source of information required to achieve goal:

RWR Enemy position (bearing) Type of weapon employed Enemy Radar effectiveness in tracking own aircraft

Audio Enemy Radar effectiveness in tracking own aircraft

DDI (Link 16/MIDS/ RDR). Enemy type/range/altitude/position, Location of formation members

HSD. Enemy range/position, Own Aircraft position

HUD· Own Aircraft position, altitude, attitude, heading, speed and g, Route/flow to target, Location of other threats

Look out· Own Aircraft position, altitude, attitude, heading, environmental conditions Enemy position / enemy weapons employed

Seat of the pants attitude, heading, speed and g

Decision(s) required to achieve goal:

Decide appropriate time / range to execute Air-to-Air RMD

Decide the direction of manoeuvre

Decide to start aggressive manoeuvre into the Notch

Decide to employ Chaff

Decide roll out on appropriate heading

Decide to set appropriate flight path

Decide update heading

Decide appropriate time / Range to transition to IRMD

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

To achieve effectiveness in Air-to-Air RMD, the pilot needs to analyse all inputs relatively fast and accurately The decisions required need to be fairly precise in timing and direction.

Physical action(s) required to achieve goal:

Look at displayed information to assess situation

Look out to assess environment / formation position / flow

Set lift vector by aggressively turning stick in proper direction to roll A/C

Level of precision/accuracy required to perform the preceding action(s):

Lift vector set +/- 15 deg of roll
Power setting within appropriate range (MAX, Mil, Sub MIL, Idle)
Pull g @ +/- 1 g
Dispense Chaff at appropriate time +/- 5 sec
Roll out and update heading to +/- 10 deg

CF18 Air to Ground IFP Analysis Results

Select high power setting

Pull Maximum G available by pulling stick back to stops

Dispense Chaff program

Roll out on appropriate heading

Set downward flight path (either push in neg g or roll and pull down)

Look at displays / look out (repeated)

Turn to updated heading (repeated)

Dispense Chaff (repeated)

Reduce power setting

Set lift vector for IRMD and pull maximum g

Set flight path +/- 20 deg

Type of feedback required to know that goal has been achieved:

Visual, Auditory, cognitive

Source of feedback required to know that goal has been achieved:

RWR
Audio feedback from RWR
RDR/MIDS display
Visual lookout
Radio transmission from formation member

Factor(s) that influence the achievement of the goal:

Fast rate of roll while performing lift vector placement
Manoeuvre performed under high g
Environment / background to find enemy

CF18 Air to Ground IFP Analysis Results

IP Number 7.7.3.5(a) **Goal:** Manoeuvre to a Weapons Engagement Zone **Source Task:** 7.5.2.7(a)

Description:

While conducting the intercept, the enemy aircraft will transition from one weapons engagement zone to the next. As the Aircraft approaches closer and the enemy reacts, a series of Offensive BFM manoeuvres are executed to enter and remain into WEZs

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics, enemy tactics, enemy order of battle, enemy weapons Basic Fighter Manoeuvres

Mission requirements and objectives. Specifics of the tactical situation (e.g. threat/friendly forces, weather, terrain, etc.) Details of on-going or planned activities

Aircraft position, altitude, flight path, speed, heading, g

Environmental conditions

Type of weapon employed

Enemy type, range, altitude, position, flight path, speed, heading, g

Source of information required to achieve goal:

Visual Specifics of the tactical situation (e.g. threat/friendly forces, weather, terrain, etc.) Details of on-going or planned activities. Aircraft position, altitude, flight path, speed, heading, g. Environmental conditions. Enemy type, range, altitude, position, flight path, speed, heading, g.

HUD Aircraft position, altitude, flight path, speed, heading, g. Type of weapon employed. Enemy type, range, altitude, position, flight path, heading

Link 16/MIDS Specifics of the tactical situation (e.g. threat/friendly forces, etc.) Details of on-going or planned activities. Enemy type, range, altitude, position.

RDR Enemy type, range, altitude, position, speed, heading, g

RWR Specifics of the tactical situation (e.g. threat)

Decision(s) required to achieve goal:

Decide to Manoeuvre to a Weapons Engagement Zone

Decide to set lift vector to desired position (repeated)

Decide apply/relax g (repeated)

Decide to adjust Power (repeated)

Decide to reposition as required

Decide that CF-18 is in a position relative to the enemy where Air-to-Air weapons can be employed

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Very high

Manoeuvering to WEZ while performing BFM requires a very level of precision/accuracy in the reasoning. BFM is one of the most challenging tasks for the pilot.

Timing: the timing to start the Manoeuvering to a weapons engagement zone requires a precision of 1-2 sec

Airspeed: the airspeed should be kept within 20 kts of ideal.

Lift vector placement: Within 10 deg of ideal position

G: the precision required in the amount of g to be set is dependent on lift vector placement, airspeed, position and bandits reaction. Nevertheless, the reasoning should aim to set within 1 g of required

Timing for reposition: within 1-2 sec of required

Precision required for assessment that Aircraft position within WEZ: 1-2 sec, sometimes the pilot has less time than required to perform the assessment.

CF18 Air to Ground IFP Analysis Results

Physical action(s) required to achieve goal:

Look at HUD (repeated)
Look out (repeated)
Move stick to roll Aircraft (setting lift vector) (repeated)
Move throttles to adjust airspeed (repeated)
Pull back on stick to apply g (repeated)
Push on stick to unload to 0 g (repeated)
Move stick to make appropriate corrections (repeated)

Level of precision/accuracy required to perform the preceding action(s):

Very high

The level of precision/accuracy is directly linked to the reasoning precision required

Additionally:

Stick movement: the stick should be moved to set and maintain desired g within 1 g. The desired bank angle set within 10 deg.

Throttles: Should be set to be within desired quadrant (Idle, Mil, Min A/B, Max A/B)

Type of feedback required to know that goal has been achieved:

Visual, Cognitive, Auditory, Psychomotor

Source of feedback required to know that goal has been achieved:

Visual

HUD
RDR

Factor(s) that influence the achievement of the goal:

Altitude
Airspeed
Type of enemy and manoeuvering
Aggressiveness
Energy advantage before engagement
Ability to manoeuvre aircraft under high g
Disorientation
Configuration
Type of weapons employed
Rdr performance

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 3 5(c) **Goal:** Employ Weapons **Source Task:** 7 5 2 7(c)

Description:

Select the desired A/A weapon via HOTAS Ensure that a valid solution is displayed Employ A/A weapons by pressing the trigger on the control stick Monitor weapon fly out and support missile if required

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics

Aircraft altitude, flight path, speed, AOA, environmental conditions Enemy type, range, altitude, position, aspect, speed

Type of weapon selected, weapon status

Master Arm status

Valid Weapon solution displayed

Weapon release command received by aircraft

Weapon fly out parameters

Source of information required to achieve goal:

HUD Aircraft altitude, flight path, speed, AOA Enemy type, range, altitude, position, aspect, speed Type of weapon selected Master Arm status, Valid Weapon solution displayed Weapon release command received by aircraft

SMS page Type of weapon selected, weapon status

Visually Aircraft altitude, flight path, speed, AOA, environmental conditions Enemy type, range, altitude, position, aspect, speed Weapon release command received by aircraft Weapon fly out parameters

Master Arm switch Master Arm status

RDR Weapon fly out parameters

Decision(s) required to achieve goal:

Decide to Employ A/A weapons

Decide to select desired A/A weapon

Decide to validate weapon solution

Decide to fire weapon

Decide to monitor weapon fly out

Decide to manoeuvre aircraft (if required)

Decide that A/A weapon were launched effectively to destroy the enemy

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The precision/accuracy required to ensure all parameters are met prior to release is 1-3 sec

A valid weapon solution may only be present for a very short time (2 sec +), a high level of precision is required to fire A/A weapon in that case, and requires a trigger impulse within the time frame the solution is valid, within 0 5 sec

If manoeuvering is required post weapon employment and supporting a weapon, the aircraft must stay within the RDR coverage, within 5 deg in azimuth and elevation from the boundaries

Physical action(s) required to achieve goal:

Select Master Arm switch to Arm (if required)
Move weapon select switch on Hotas to select desired A/A weapon
Look out (repeated)
Look at displays (repeated)
Look at HUD (repeated)
Press the trigger switch on Hotas with right index
Move controls to manoeuvre aircraft (if required)

Level of precision/accuracy required to perform the preceding action(s):

Medium

The physical actions are directly linked to the precision required in the reasoning

The weapon select switch has to be move in the proper direction to select the desired weapon

CF18 Air to Ground IFP Analysis Results

Type of feedback required to know that goal has been achieved:

Visual, Cognitive, Auditory

Source of feedback required to know that goal has been achieved:

Visual

HUD
RDR
AMIRS

Factor(s) that influence the achievement of the goal:

Altitude
Type of weapon
RDR performance
Enemy manoeuvering
Background
Airspeed
AOA
Weapon Pk
Shot doctrine
Quality of solution at release

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 3 5(e) **Goal:** Egress Engagement Safely **Source Task:** 7 5 2 5(f)

Description:

Once enemy attack has been negated, egress engagement by unloading the aircraft while applying maximum power Employ a series of check turns to visually monitor threat

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics, enemy tactics, enemy order of battle, enemy weapons Basic Fighter Manoeuvres

Aircraft altitude/flight path/speed, environmental conditions

Enemy type/range/altitude/position

Enemy's ability to reacquire radar lock on

Other threats location

General situation, flow, direction towards safe area

Source of information required to achieve goal:

RWR Enemy's ability to reacquire radar lock on, Enemy type/range/altitude/position

DDI (Link 16/MIDS/ RDR): Enemy type/range/altitude/position, General situation, flow, direction towards safe area

HSD Enemy range/position, Other threats location , flow, direction towards safe area

HUD Own Aircraft position, altitude, attitude, heading, speed and g

Look out: Own Aircraft position, altitude, attitude, heading, Enemy type/range/altitude/position/ heading

Seat of the pants attitude, heading, speed and g

Communications General situation, flow, direction towards safe area

Decision(s) required to achieve goal:

Decide that enemy is no longer an immediate threat (Enemy attack has been negated)

Decide to egress

Decide egress direction

Decide to manoeuvre Aircraft toward egress direction

Decide to visually monitor threat and assess egress

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The decision that the enemy is no longer a threat has to be accurate
Due to the proximity of the threat, the decision to egress has to be taken at the optimum time
The direction chosen also requires precision of approximately +/- 20 degrees

Physical action(s) required to achieve goal:

Look at the enemy visually

Look at the displays

Turn towards egress direction

Apply Maximum power

Unload to 0 g

Look back at threat

Turn Aircraft to updated direction (Check turns)

Level of precision/accuracy required to perform the preceding action(s):

Power setting within appropriate range (MAX, Mil, Sub MIL, Idle)
Unload @ +/- 0 5 g
Roll out and update heading to +/- 10 deg
Set flight path +/- 20 deg

CF18 Air to Ground IFP Analysis Results

Type of feedback required to know that goal has been achieved:

Visual, Auditory, Cognitive

Source of feedback required to know that goal has been achieved:

Visual lookout
RWR
LINK 16/MIDS
Displays for threat information

Factor(s) that influence the achievement of the goal:

Difficult to look over the shoulder to maintain tally on enemy
Flying priority is to look back at the threat

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 3 5(g) **Goal:** Monitor Weapon Fly Out **Source Task:** 7 5 2 7(g)

Description:

Monitor weapon fly out visually and support missile as required Monitor Radar display. Follow on with additional weapons if required

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics, enemy tactics, enemy order of battle, enemy weapons

Enemy type, range, altitude, position, heading, manoeuvres

Aircraft altitude, flight path, environmental conditions

Type of weapon employed

Weapon fly out parameters (TTG/Time to Go, active range)

Weapon intercept results

Enemy manoeuvres post impact

Decision(s) required to achieve goal:

Decide to monitor Weapon fly out

Decide to look out

Decide to look at displays

Decide to manoeuvre aircraft to support weapon (if required)

Decide to assess Pk (Probability of kill)

Decide to take follow on action (if required)

Decide that the weapon fly out has been monitored and assessed for results and/or follow on actions

Physical action(s) required to achieve goal:

Look at displays (repeated)
Look out (repeated)
Move controls to manoeuvre aircraft as required

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of information required to achieve goal:

HUD Aircraft altitude, flight path Enemy type, range, altitude, position, heading, manoeuvres Type of weapon employed Weapon fly out parameters (TTG/Time to Go, active range)

Visually. Aircraft altitude, flight path, environmental conditions Enemy type, range, altitude, position, heading, manoeuvres Weapon intercept results. Enemy manoeuvres post impact.

RDR Weapon fly out parameters Enemy type, range, altitude, position, heading, manoeuvres. Weapon fly out parameters (TTG/Time to Go, active range) Enemy manoeuvres post impact

AMIRS Enemy type, position, manoeuvres. Weapon intercept results Enemy manoeuvres post impact

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

High level of accuracy is required to assess the weapon fly out Pk The enemy manoeuvres required to be monitored in heading (within 5 degrees). Additionally, countermeasures, manoeuvering, weapon fly out need to be assessed, with a precision requiring 1-2sec every time the pilot looks at the information.

If manoeuvering is required post weapon employment and supporting a weapon, the aircraft must stay within the RDR coverage, within 5 deg in azimuth and elevation from the boundaries

Level of precision/accuracy required to perform the preceding action(s):

Medium

The physical actions are directly linked to the precision required in the reasoning.

Source of feedback required to know that goal has been achieved:

Radar display
Visual
HUD
AMIRS

CF18 Air to Ground IFP Analysis Results

Factor(s) that influence the achievement of the goal:

Type of weapon
Range
Altitude
Speed
Aspect
Manoeuvres
SA
Other threats
Countermeasures
Radar performance
Tactical situation

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 4 1(a) **Goal:** Conduct Visual Lookout **Source Task:** 7 4 2 1(a)

Description:

The pilot conducts a visual lookout by scanning the airspace in a 360 degree pattern around his aircraft The visual lookout provides a final layer of protection against undetected air-to-air or surface-to-air threats or targets that may be trying to engage the pilot's formation of aircraft.

Information required to achieve goal:

Visual lookout procedures, tactics, enemy tactics, enemy order of battle, enemy weapons.

Aircraft altitude, flight path, speed, environmental conditions

Presence of threats within area of responsibility

Source of information required to achieve goal:

HUD Own Aircraft altitude, flight path, speed

Visual. Own Aircraft altitude, flight path, speed, environmental conditions Presence of threats within area of responsibility

Decision(s) required to achieve goal:

Decide to conduct visual look out

Decide to actively and methodically scan surroundings

Decide focus distance

Decide on type of scan pattern

Decide that a detailed scan of the airspace surrounding the aircraft and the formation was conducted in order to detect enemy SAMs and AAA

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The visual lookout requires the pilot to be methodical and precise to be effective in his approach to scanning the surroundings.

The pilot should select the appropriate quadrant to conduct his look out, and alternate between them based on a priority system and a % of importance (varies with the situation)

Focus distance within 5 nm of desired (this precision decreases with range)

The precision/accuracy in attending the goal of Visual lookout requires 8-16 sec

The level of precision required each time the pilot looks out to scan one of the quadrants is 2-4 sec

Physical action(s) required to achieve goal:

Look at HUD/displays

Look out by visually scanning the outside world in a pattern that covers area of responsibility, up to 360 degrees

Level of precision/accuracy required to perform the preceding action(s):

Medium

The visual look out follows a preset pattern to be more effective

The precision in the physical actions is directly linked to the reasoning.

Type of feedback required to know that goal has been achieved:

Visual, cognitive

Source of feedback required to know that goal has been achieved:

Visually

Factor(s) that influence the achievement of the goal:

Environment / Background
Sun's position
Number of aircraft in the formation

CF18 Air to Ground IFP Analysis Results

Eyesight
Focus distance
Size and aspect of visual contacts
Visual cues from visual contacts (ex : smoke, contrails, movement)

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 4 1(b) **Goal:** Respond to displayed RWR Threat Emission Information **Source Task:** 7 4 2 1(b)

Description:

The primary reference for displayed RWR threat emission information is the HSD When a spike is displayed visually/aurally to the pilot, his reaction will be based on the range and lethality of the spike. If he can correlate the spike to a non-lethal threat, his reaction will likely be to continue to remain outside the threat's lethal engagement zone, or to engage and kill the enemy before it has an opportunity to engage his aircraft

If he correlates the spike on his HSD to a threat that poses a lethal threat to his aircraft, the pilot must react defensively He will use a combination of aggressive manoeuvres, chaff/flare, jamming, and deception to try and defeat the enemy radar and/or missiles

If the spike is uncorrelated, the pilot must react as if he is within the lethal range of the threat being presented to him

Information required to achieve goal:

Enemy type/range/altitude/position

Type of weapon employed

Enemy / friendly illumination

Own Aircraft position, altitude, attitude, heading, speed and g

Enemy Radar effectiveness in tracking own aircraft

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics, enemy tactics, enemy order of battle, enemy weapons RWR interpretation

Source of information required to achieve goal:

RWR Enemy type/ range/position (bearing). Type of weapon employed Enemy Radar effectiveness in tracking own aircraft Enemy / friendly illumination

DDI (Link 16/MIDS/ RDR) Enemy type/range/altitude/position

HSD Enemy range/position

HUD Own Aircraft position, altitude, attitude, heading, speed and g

Look out: Own Aircraft position, altitude, attitude, heading,

Seat of the pants: attitude, heading, speed and g

DDI , HSD, Audio

Decision(s) required to achieve goal:

Decide appropriate defensive manoeuvre

Decide if threat displayed warrant response

Decide on appropriate counter measures

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Ability to differentiate between Surface and Air threat. Differentiate type of air threats Type of response similar for all air threats, specific type of threat will help fine tune reaction

Physical action(s) required to achieve goal:

Look at displayed information
May require inputs to RDR display via HOTAS

Level of precision/accuracy required to perform the preceding action(s):

Medium

Information displayed is in obvious format Recognition of type of information requires some precision

Type of feedback required to know that goal has been achieved:

Visual, Auditory

Source of feedback required to know that goal has been achieved:

RWR
Audio feedback from RWR
RDR/MIDS display

CF18 Air to Ground IFP Analysis Results

	Visual lookout Radio transmission from formation member

Factor(s) that influence the achievement of the goal:

Decision to proceed to the merge as a formation (winning/losing decision)
Environment

CF18 Air to Ground IFP Analysis Results

IP Number 7 7.4 1(d) **Goal:** Conduct Visual Lookout with NVG **Source Task:** 7 4 2 1(g)

Description:

The NVG-equipped pilot conducts a visual lookout by scanning the airspace in a 360 degree pattern around his aircraft The visual lookout provides a final layer of protection against undetected air-to-air or surface-to-air threats and targets that may be trying to engage the pilot's formation of aircraft

Information required to achieve goal:

Visual lookout procedures with NVG, tactics, enemy tactics, enemy order of battle, enemy weapons

Aircraft altitude/flight path/speed, environmental conditions

Lighting conditions

Source of information required to achieve goal:

HUD Own Aircraft altitude, flight path, speed

Visual Own Aircraft altitude, flight path, speed, environmental conditions Lighting conditions

Decision(s) required to achieve goal:

Decide to conduct visual look out with NVG

Decide to actively and methodically scan surroundings

Decide on type of scan pattern

Decide that a detailed scan of the airspace surrounding the aircraft and the formation was conducted in order to detect enemy SAMs and AAA

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The visual lookout requires the pilot to be methodical and precise to be effective in his approach to scanning the surroundings

The pilot should select the appropriate quadrant to conduct his look out, and alternate between them based on a priority system and a % of importance (varies with the situation)

The precision/accuracy in attending the goal of Visual lookout with NVG requires 12-20 sec

The level of precision required each time the pilot looks out to scan one of the quadrants is 3-5 sec.

Physical action(s) required to achieve goal:

Look at HUD/displays

Look out by visually scanning the outside world in a pattern that covers area of responsibility, up to 360 degrees

Level of precision/accuracy required to perform the preceding action(s):

Medium

The visual look out with NVGs follows a preset pattern to be more effective The precision in the physical actions is directly linked to the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visually

Factor(s) that influence the achievement of the goal:

Environment
Lighting intensity (Moon, cities)
Range
NVG FOV
Number of aircraft in the formation
Eyesight

CF18 Air to Ground IFP Analysis Results

Size and aspect of visual contacts
Visual cues from visual contacts (ex : movement, lights)

CF18 Air to Ground IFP Analysis Results

IP Number 7.7.4.1(c) **Goal:** Advise on Visually Acquired SAM/AAA **Source Task:** 7.3.2.2(f)

Description:

The pilot advises formation members and controlling agency on visually acquired threats by voice on Have quick II radio, discreet radio or by Data Link communications. If immediate actions are required, the pilot will conduct a Directive then Descriptive commentary of the visually acquired threats. If no Immediate action are required, then the pilot uses the standardized description of the visually acquired contacts location and information.

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics, enemy tactics, enemy order of battle, enemy weapons Tactical communication procedures

Enemy SAM/AAA type/range/altitude/position. Type of weapon employed

Formation Member position

Source of information required to achieve goal:

Visual look out: Enemy SAM/AAA type/range/altitude/position. Type of weapon employed

Link 16/MIDS display: Formation Member position

RWR: Enemy SAAM/AAA type/range/altitude/position. Type of weapon employed

Decision(s) required to achieve goal:

Decide if threat is a factor to the formation

Decide if threat warrants Directive then Description commentary

Decide to communicate directions

Decide to communicate threat information

Decide that the detected threat information was passed to formation members in a clear and concise manner using directive then descriptive commentary

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

Pilot has to recognize that the threat is a factor to the formation, then if appropriate choose the proper directive call and with precision/accuracy, describe the threat and its location

Threat should be describe with following precision: position within 1 hr in o'clock scale, Low/level/high in elevation, range within 1-2 nm

Physical action(s) required to achieve goal:

Look at displays

Look out

Key the comm switch

Make the commentary

Level of precision/accuracy required to perform the preceding action(s):

Medium

Some precision required in the look out technique to acquire threat visually

The level of precision is directly linked to the reasoning

Type of feedback required to know that goal has been achieved:

Auditory, Visual

Source of feedback required to know that goal has been achieved:

Radio Response from formation member

Visually seeing formation member's reaction

Factor(s) that influence the achievement of the goal:

Comm jamming
Proximity of the threat
Altitude of the formation

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 5 1(a) **Goal:** Employ High Speed Flight **Source Task:** 7 7 5 1(a)

Description:

Accomplished by advancing the throttles, usually to at least MIL power or higher, and allowing the aircraft to accelerate along a level to slightly descending flight path. Once the desired airspeed is attained, the throttles are adjusted as required to maintain the target speed, and aircraft attitude is adjusted in a conventional manner reference the velocity vector in the HUD. As well, during high speed flight, heavy manoeuvering is kept to a minimum to avoid depletion of aircraft energy due to load forces.

Information required to achieve goal:

Aircraft operating instructions, aircraft handling techniques, standard operating procedures, specific orders and regulations

Mission requirements/objectives, fuel status, environmental conditions, tactical situation.

Aircraft position, altitude, airspeed, ground speed, flight path, heading, and g

Source of information required to achieve goal:

HUD Aircraft position, altitude, airspeed, ground speed, flight path, heading, and g

Link 16/MIDS Mission requirements/objectives, tactical situation Aircraft position

HSD fuel status Aircraft position, airspeed, ground speed, heading, and g

Visual Aircraft position, altitude, airspeed, ground speed, flight path, heading

Fuel QTY indicators fuel status

Decision(s) required to achieve goal:

Decide to employ high speed flight

Decide to adjust airspeed / ground speed

Decide that high speed flight is safely and efficiently conducted

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The level of accuracy/precision when employing high speed flight requires the pilot to fly within 30 kts of desired airspeed

Physical action(s) required to achieve goal:

Look out
Look at displays
Move throttles to adjust airspeed
Move controls to maintain desired flight path

Level of precision/accuracy required to perform the preceding action(s):

Medium

The level of precision is directly linked to the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive, Psychomotor, Auditory

Source of feedback required to know that goal has been achieved:

HUD

Visual

Factor(s) that influence the achievement of the goal:

Altitude
Fuel remaining
Safety
Comfort level
Terrain
Threats

CF18 Air to Ground IFP Analysis Results

Configuration
Restrictions

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 5.1(c) **Goal:** Avoid Threat Envelopes **Source Task:** 7 7 5 1(c)

Description:

During the mission planning phase all known threat envelopes are plotted reference the mission routing using the most current intelligence reports Formation altitude, routing, and tactics are then decided upon that will ensure that all known threats are avoided to the maximum extent possible Once in-flight, the pilot references his HSD to note his present position, flight path, and the location of all known threat envelopes displayed via MIDS If his flight path will fall inside one of the threat rings depicted on the HSD (normally a red ring or a red 3-D volume of airspace), he manoeuvers laterally and/or vertically to ensure the threat ring will be avoided Aircraft speed may also be adjusted in order to achieve the desired result

Information required to achieve goal:

Standard operating procedures, classified aircraft operating procedures, intelligence on enemy electronic order of battle, tactics

Mission objectives/priorities, routing, tactical situation, weather, terrain

Threat activity and location Type of threat

Aircraft position, altitude, attitude, heading, speed and g

Source of information required to achieve goal:

HSD Aircraft position, threat location, threat envelopes, routing

Link 16/MIDS display: Aircraft position, threat location, threat envelopes, tactical situation,

RWR Type of threat

HUD Aircraft altitude, attitude, heading, speed and g

Visual lookout Threat activity and location, Aircraft altitude, attitude, heading, speed

Seat of the pants Aircraft speed and g

Decision(s) required to achieve goal:

Decide best route/flight path to avoid threats

Decide to follow adjusted routing

Decide to change altitude as required

Decide to increase Airspeed

Type of reasoning required to achieve goal:

knowledge

Level of precision/accuracy required for the above type of reasoning:

Medium

The reasoning required to avoid threat envelopes has to be precise enough to take the appropriate course of action to achieve goal, while usually a few different course/option are probably reasonable.

Physical action(s) required to achieve goal:

Look at displays

Look out

Turn Aircraft to new heading by turning stick in the direction required, then pull and sustain required g to achieve desired turn rate

Increase speed by moving throttle to new position

Change flight path

Level of precision/accuracy required to perform the preceding action(s):

Power setting within appropriate range (MAX, Mil, Sub MIL, Idle)
G load @ +/- 2 g
Roll out heading to +/- 30 deg
Set flight path +/- 20 deg

Type of feedback required to know that goal has been achieved:

Visual, Auditory

Source of feedback required to know that goal has been achieved:

RWR
HSD
Link 16/MIDS
Visual Look out

CF18 Air to Ground IFP Analysis Results

Factor(s) that influence the achievement of the goal:

Number of threats in area

CF18 Air to Ground IFP Analysis Results

IP Number 7.7.5.1(d) **Goal:** Monitor Target Area Tactical Picture on LINK 16/MIDS Displays **Source Task:** 7.2.2.1(m)

Description:

Adjust and/or confirm LINK 16/MIDS Tactical Display parameters to ensure the desired airspace in the Target area is covered. Observe picture being built on the LINK 16/MIDS Tactical Display. Visually confirm position of formation members as well as other Friendly Aircraft, Elements or Sections conducting operation within the target area. Monitor Adversary Disposition in the target Area by analyzing displayed information. Mentally build general picture and situational awareness

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, Link 16 displays/controls.

Tactical situation, phase of mission, mission objectives/requirements, correlation of displayed information with information displayed from other sources.

Weather, terrain

Friendlies activity and location

Threat activity and location

Target location

Source of information required to achieve goal:

Link 16 MIDS: Tactical situation, phase of mission, Friendlies activity and location, Threat activity and location. Target location

HUD/RDR/AMIRS/HSD displays: correlation of information, Friendlies activity and location, Threat activity and location. Target location

Visual: Weather, terrain. Friendlies activity and location, Threat activity and location. Target location

Decision(s) required to achieve goal:

Decide to monitor target area tactical picture

Decide to adjust the Link16/MIDS display parameters

Decide to look at Link 16/MIDS tactical display

Decide to correlate information with other sources

Decide that the target area picture has been built

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Pilot has to analyse displayed information with some accuracy to understand the target area picture and monitor it. The accuracy required depends greatly on the amount of information displayed. For 0-1 contacts ~ 0.5-1 sec. For 2-3 contacts ~1-2 sec. For more than 3 contacts, 1-4sec

Physical action(s) required to achieve goal:

Look at Link 16/MIDS display (repeated)

Adjust display parameters via Hotas or pushbuttons

Look at other displays

Level of precision/accuracy required to perform the preceding action(s):

Medium

Pilot has to look at entire picture presented, but also at each detail to build the meaning and understand picture mentally. Precision is directly linked to the reasoning.

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Link 16/MIDS

HUD/RDR/AMIRS/HSD displays

Factor(s) that influence the achievement of the goal:

Amount of information presented at one time

CF18 Air to Ground IFP Analysis Results

Complexity of tactical picture
Rate of change in situation
Range of contacts
Threats vs friendlies contacts

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 5 2(c) **Goal:** Dispense Chaff **Source Task:** 7.5 2 3(b)

Description:

Chaff is dispensed by selecting the desired program on the ALE-47 controls, and either by activating the canopy panic button or via HOTAS controls

Information required to achieve goal:

Aircraft operating instructions DEWS/ ALE-47 operating instructions

Mission objectives/priorities, tactical situation, weather, terrain, threat activity and location Intelligence on enemy electronic order of battle,

Type of threat

Status of defensive countermeasures, program, mode

Aircraft g loading

Source of information required to achieve goal:

HUD Aircraft g loading, Type of threat

RWR Type of threat, threat activity and location

Link 16/MIDS Type of threat, tactical situation, threat activity and location

ALE-47/DEWS Status of defensive countermeasures, program, mode

Decision(s) required to achieve goal:

Decide to dispense Chaff

Decide to use a program of Chaff

Decide to use Chaff in single bundles

Decide to stop dispensing Chaff

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The chaff should be dispensed at the appropriate time (very situation specific), but generally within 1-5 sec of ideal time

Accuracy is required in the method of dispensing chaff (panic button for pre-program chaff, HOTAS for single Chaff bundles)

Accuracy in the number of Chaff used is important due to the limited number available.

Physical action(s) required to achieve goal:

Look at DEWS controls

Look out

Select proper programming on the DEWS controls with left hand (if required)

Hit the canopy panic button with left hand

Move C/F switch backward with left thumb

Level of precision/accuracy required to perform the preceding action(s):

Medium

The canopy panic button has to be hit with an accuracy within 3 -4 cm (otherwise it is missed)

The C/F switch has to be move backward (vs forward) approximately 1 cm

Type of feedback required to know that goal has been achieved:

Visual, Auditory, Cognitive

Source of feedback required to know that goal has been achieved:

Visual
ALE-47/DEWS console
Noise at delivery

CF18 Air to Ground IFP Analysis Results

Factor(s) that influence the achievement of the goal:

Number of Chaff remaining
Winds
G loading at release

CF18 Air to Ground IFP Analysis Results

IP Number 7 7 5 3(a) **Goal:** Limit Exposure Using Terrain Masking **Source Task:** 7 7 2 1(f)

Description:

If able, aircraft routing is chosen during the mission planning phase to maximize the pilot's ability to exploit the terrain along his route to his advantage. If not, the pilot chooses his flight path visually and then descends his aircraft to low altitude The pilot manoeuvers his aircraft laterally and vertically in order to ensure that the local terrain blocks the line-of-sight between his aircraft and the enemy

Information required to achieve goal:

Intelligence on enemy electronic order of battle Classified aircraft operating instructions

Threat location, Type of threat, Tactical situation Line-of-sight between own position and threat

Aircraft airspeed, attitude, altitude above ground, g.

Terrain (Hills, Valleys, Rivers. .)

Source of information required to achieve goal:

Visual Threat location, Type of threat, Tactical situation. Line-of-sight between own position and threat Aircraft airspeed, attitude, altitude above ground, g Terrain (Hills, Valleys, Rivers ..)

Maps: Threat location, Type of threat, Tactical situation. Line-of-sight between own position and threat Terrain (Hills, Valleys, Rivers. .)

HUD Threat location, Type of threat, Tactical situation Aircraft airspeed, attitude, altitude above ground, g

RWR: Threat location, Type of threat.

HSD Threat location, Type of threat, Tactical situation Line-of-sight between own position and threat Terrain (Hills, Valleys, Rivers.)

Link 16/MIDS: Threat location, Type of threat, Tactical situation

Decision(s) required to achieve goal:

Decide to use terrain masking

Decide to find expected threat position

Decide to find best routing that will limit exposure by using terrain masking

Decide to look out

Decide to fly at low altitude

Decide to manoeuvre aircraft to limit exposure

Decide that terrain masking is no longer required

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

The pilot should have a good idea of the threat position, ideally within 30 degrees in azimuth

The pilot will attempt to fly at an altitude of 100-150 ft, +100ft to - 0ft Airspeed should be maintained within 30 kts of desired

Physical action(s) required to achieve goal:

Look at Maps
Look at displays
Look out
Manoeuvre aircraft via stick and throttles

Level of precision/accuracy required to perform the preceding action(s):

Medium

The task of looking at Maps/displays is equivalent to 1-3sec of attending time

CF18 Air to Ground IFP Analysis Results

The precision required in the movement of aircraft controls is directly linked to the precision required in the reasoning

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual
RWR
HUD
HSD
Link 16/MIDS

Factor(s) that influence the achievement of the goal:

Type of terrain
Threat location
Safety hazards at low level
Requirement to avoid being too predictive (flying down the only obvious valley)
Comfort level
Other taskings (Air-to-air engagement, weapon delivery)
Routing (Try to optimize terrain masking vs still get to the target)

CF18 Air to Ground IFP Analysis Results

IP Number 7.7.6.1(b) **Goal:** Employ Defensive Counter Measures **Source Task:** 7.7.6.1(b)

Description:

As part of his systems check on the ground the pilot ensures that the defensive counter measures suite is loaded and configured properly He then ensures it passes all respective BIT tests on start-up During the fence-in check, the pilot ensures the system is set to AUTO to allow systems such as on-board jammers to function in their normal, automatic mode The HSD and HUD are the primary references for RWR and HSD information for the pilot when he is employing defensive countermeasures Using this displayed information, the pilot will position his aircraft so as to maximize the effectiveness of his RWR and Jammer Conventional defensive counter measures such as heavy manoeuvering, AAMD, IRCM, and the employment of chaff/flare from the ALE-47 will be used as the pilot deems fit to optimize the desired result

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, DEWS operating procedures, enemy electronic order of battle, tactics, intelligence reports

Mission objectives/priorities, tactical situation, weather, terrain, threat activity and location, stage of mission

DEWS switches position, DEWS status, number of countermeasures remaining

Decision(s) required to achieve goal:

Decide to position aircraft to maximize DEWS effectiveness
Decide to use heavy manoeuvering, AAMD, IRCM
Decide to employ Chaff / flare

Physical action(s) required to achieve goal:

Manoeuvre aircraft via stick and throttles
Visually look at displayed information
Activate ALE-47 with left hand via panic button and/or Chaff/flare switch with left thumb

Type of feedback required to know that goal has been achieved:

Visual, Auditory, cognitive

Factor(s) that influence the achievement of the goal:

Number of countermeasures remaining
Type of threat
Number of threat (High/ medium / Low threat scenario)
Exposure / vulnerability
Use of countermeasures vs attracting attention
Belief that you are undetected

Source of information required to achieve goal:

Link 16/MIDS display. tactical situation, threat activity and location

HSD threat activity and location, stage of mission

HUD. threat activity and location, stage of mission

DEWS controls and displays DEWS switches position, DEWS status, number of countermeasures remaining

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

High SA required for the timely use of Defensive counter measures

Level of precision/accuracy required to perform the preceding action(s):

Medium

Pilot required to activate ALE-47 controls with some precision

Source of feedback required to know that goal has been achieved:

DEWS displays
Visually

CF18 Air to Ground IFP Analysis Results

IP Number 7 7.6 3(a) **Goal:** Employ Surface-to-Air RMD **Source Task:** 7 7 6.3(a)

Description:

Using all information available at the time the pilot will try and determine the type/azimuth/range/status of the radar that is illuminating his RWR. Assuming the surface-to-air threat is of a critical nature, the pilot will turn aggressively to place the threat radar at his 3 or 9 o'clock position while descending and deploying chaff He will make use of terrain masking if practical He will ensure, using his HSD and HUD, that he maintains the enemy radar signal on his wing line, and that his on-board jammer is working to defeat the host radar and any inbound missiles He will continue to use chaff and begin a visual lookout If missiles are visually sighted and considered a threat, a visual missile defence is executed

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, tactics, enemy tactics, enemy order of battle, enemy weapons Intelligence reports, Tactical communication procedures

Aircraft altitude, airspeed, attitude, g, aircraft configuration, status of defensive countermeasures, tactical situation, risk of follow on engagement by other enemy threats

Enemy SAM type, range, position (bearing) Type of weapon employed

Environmental conditions

Radar effectiveness in tracking own aircraft

Weapon effectiveness in tracking own aircraft

Route/flow to target

Location of formation members

Decision(s) required to achieve goal:

Decide if SAM is threat to own Aircraft

Decide to employ Surface-to-Air RMD

Decide if threat radar is within range to warrant response

Decide to start aggressive manoeuvre to place missile on wing line (Notch)

Decide to employ Chaff (repeated)

Decide roll out on appropriate heading

Decide to set appropriate flight path

Decide to use terrain masking

Decide to update Notch (90 deg from threat)

Source of information required to achieve goal:

Visual Aircraft altitude, airspeed, attitude, aircraft configuration. Enemy SAM type, range, position (bearing) Type of weapon employed Environmental conditions Weapon effectiveness in tracking own aircraft Location of formation members

DDI (Link 16/MIDS, RDR, AMIRS) tactical situation, risk of follow on engagement by other enemy threats Enemy SAM type, range, position (bearing) Route/flow to target Location of formation members.

HUD Aircraft altitude, airspeed, attitude, g Enemy SAM type, bearing Type of weapon employed Radar effectiveness in tracking own aircraft Route/flow to target

HSD Enemy SAM type, range, position (bearing) Route/flow to target Location of formation members

RWR/DEWS status of defensive countermeasures, risk of follow on engagement by other enemy threats Enemy SAM type, position (bearing) Type of weapon employed Radar effectiveness in tracking own aircraft. Weapon effectiveness in tracking own aircraft

Seat of the pants: attitude, speed and g

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The manoeuvre requires high level of reasoning to determine the appropriate time / range to break into the radar and the missile

The accuracy required to decide if the SAM is a threat to own aircraft is based on factors such as SAM type of pursuit, if the missile is lagging own position by 30 deg or more, the SAM is probably no longer a threat

The aggressive manoeuvering is required to put the missile on the wing line within 10 deg. The timing for employing Chaff should start not later then 2-4 sec of Radar illumination, depending on range (and time to intercept)

The break into the missile requires a lot of precision in the timing Too early will not give a big

CF18 Air to Ground IFP Analysis Results

Decide to optimize jammers effectiveness

Decide to look out

Decide appropriate time / range to break into the missile

Decide that RMD was properly executed to ensure survivability against surface-to-air threats

problem to the SAM, too late and the SAM hits Timing should fall within 1-2 sec of ideal time (specific distance from aircraft, could be sensitive/classified)

Physical action(s) required to achieve goal:

Look at displays to assess Radar threat

Look out to assess missile threat

Set lift vector by aggressively turning stick in proper direction to roll A/C

Pull Maximum G available by pulling stick back to stops

Adjust power setting with the throttles

Dispense Chaff by actioning the C/F switch on the throttles (repeated)

Roll out on appropriate heading

Look out (repeated)

Move controls to manoeuvre aircraft to use terrain masking

Adjust heading with stick

Set lift vector for Last ditch 3-D manoeuvre by aggressively turning stick in proper direction to roll A/C

Pull Maximum G available by pulling stick back to stops

Level of precision/accuracy required to perform the preceding action(s):

Lift vector set +/- 15 deg of roll
Power setting within appropriate range (MAX, Mil, Sub MIL, Idle)
Pull g @ +/- 1 g
Dispense Chaff at appropriate time +/- 2 sec
Roll out and update heading to +/- 10 deg
Start 3D break into the missile +/- 2 sec

Type of feedback required to know that goal has been achieved:

Visual, Auditory, Cognitive

Source of feedback required to know that goal has been achieved:

Visually

RWR
Communication from formation member

Factor(s) that influence the achievement of the goal:

Number of countermeasures remaining
Type of threat
Number of threat (High/ medium / Low threat scenario)
Exposure / vulnerability
Aggressiveness
Range

CF18 Air to Ground IFP Analysis Results

IP Number 7.7.6.3(b) **Goal:** Employ Surface-to-Air IRMD

Source Task: 7.7.6.3(b)

Description:

After sighting the missile launch, the pilot will assess whether or not it poses a threat to him. If he determines it does, he will manoeuver hard to place the missile on his wing line. As he rolls out of the turn he will reduce his throttles and begin employing IRCM. He will also deploy flares from his ALE-47 as per SOPs. With approximately 3-5 seconds prior to missile intercept the pilot will carry out a visual 3-D barrel roll manoeuver around the inbound missile and begin deploying flares at a higher rate, in order to ensure a significant miss distance occurs before the missile's warhead detonates.

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, enemy electronic order of battle, tactics, intelligence reports

Aircraft altitude/airspeed, attitude, g, aircraft configuration, status of defensive countermeasures, tactical situation, risk of follow on engagement by other enemy threats

Environmental conditions

SAM position / direction / range

Weapon effectiveness in tracking own aircraft

Route/flow to target

Location of other threats

Location of formation members

Decision(s) required to achieve goal:

Decide if SAM is threat to own Aircraft

Decide if threat is within range to reach own Aircraft

Decide to start aggressive manoeuvre to place missile on wing line

Decide to employ IRCM / Flares

Decide roll out on appropriate heading

Decide to set appropriate flight path

Decide appropriate time / range to break into the missile

Decide to employ Flares

Source of information required to achieve goal:

Visual: SAM position (bearing). Type of weapon employed. Weapon effectiveness in tracking own aircraft

DDI (Link 16/MIDS/ RDR): Location of formation members, location of other threats

HUD: Aircraft altitude /airspeed

HSD: Route/flow to target

Look out: Aircraft position, altitude, attitude, environmental conditions. SAM position / direction / range

Seat of the pants: attitude, speed and g

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The manoeuvre requires high level of reasoning to determine the appropriate time / range to break into the missile

The accuracy required to decide if the SAM is a threat to own aircraft is based on factors such as SAM type of pursuit, if the missile is lagging own position by 30 deg or more, the SAM is probably no longer a threat. The pilot will have a hard time to judge if the missile is within range at close ranges, but if the IR missile is more then 5 nm away (depending on the type of IR SAM) there is a good chance that the pilot is outside of range for such a SAM

The aggressive manoeuvering is required to put the missile on the wing line within 20 deg. The timing for employing IRCM/Flares should start not later then 2-4 sec of missile launch, depending on range (and time to intercept)

The break into the missile requires a lot of precision in the timing. Too early will not give a big

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problem to the SAM, too late and the SAM hits. Timing should fall within 1-2 sec of ideal time (specific distance from aircraft, could be sensitive/classified)

Physical action(s) required to achieve goal:

Look out to assess missile threat

Set lift vector by aggressively turning stick in proper direction to roll A/C

Pull Maximum G available by pulling stick back to stops

Reduce power setting by retarding the throttles

Dispense Flares by actioning the C/F switch on the throttles

Roll out on appropriate heading

Look out (repeated)

Set lift vector for Last ditch 3-D manoeuvre by aggressively turning stick in proper direction to roll A/C

Pull Maximum G available by pulling stick back to stops

Dispense Flares by actioning the C/F switch on the throttles

Level of precision/accuracy required to perform the preceding action(s):

Lift vector set +/- 15 deg of roll
Power setting within appropriate range (MAX, Mil, Sub MIL, Idle)
Pull g @ +/- 1 g
Dispense Flares at appropriate time +/- 2 sec
Roll out and update heading to +/- 20 deg
Start 3D break into the missile +/- 2 sec

Type of feedback required to know that goal has been achieved:

Visual, cognitive

Source of feedback required to know that goal has been achieved:

Visually
Communication from formation member

Factor(s) that influence the achievement of the goal:

Proximity to the threat
Altitude
Energy (Airspeed)

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IP Number 7 7 6 3(c) **Goal:** Employ AAAD **Source Task:** 7 5 2 5(c)

Description:

Employ defensive BFM manoeuvres to negate enemy attack Assess bandit reposition and perform last ditch manoeuvring If unsuccessful, manoeuvre the aircraft into a series of Guns defence and jinks

Information required to achieve goal:

Aircraft operating procedures, standard operating procedures, classified aircraft operating procedures, enemy electronic order of battle, tactics, intelligence reports

Aircraft altitude/airspeed, Flight path, dive angle, g, heading

Status of defensive countermeasures Tactical situation, risk of follow on engagement by other enemy threats

Environmental conditions

Terrain

AAA position / direction / range

AAA radar effectiveness in tracking friendly aircraft

Route/flow to target

Location of other threats, Location of formation members

Decision(s) required to achieve goal:

Decide to look out

Decide to look at displays

Decide that the AAA is a threat

Decide to manoeuvre aircraft aggressively to defeat the threat

Decide to use defensive countermeasures (or monitor if in automatic mode)

Decide to reposition if required

Decide to recover to miss ground

Decide that the AAA is no longer a threat

Source of information required to achieve goal:

HUD Aircraft altitude/airspeed, Flight path, dive angle, g, heading AAA direction, AAA radar effectiveness in tracking friendly aircraft Route/flow to target, Location of other threats, Location of formation members

Visual Aircraft altitude/airspeed, Flight path, dive angle, heading Environmental conditions, terrain AAA position / direction / range Route/flow to target, Location of other threats, Location of formation members

RWR Risk of follow on engagement by other enemy threats AAA direction / range, AAA radar effectiveness in tracking friendly aircraft Location of other threats

HSD AAA position / direction / range, Route/flow to target Location of other threats, Location of formation members

Link 16/MIDS Tactical situation, risk of follow on engagement by other enemy threats AAA position / direction / range, Route/flow to target Location of other threats, Location of formation members

DEWS Status of defensive countermeasures

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

High

The accuracy required to decide if the AAA is a threat to own aircraft is based on factors such as AAA radar illumination and visual cues (auditory if you have been hit) If the AAA is falling way short of Aircraft position (by at least 3000 ft-6000ft), the pilot will be able to assess the AAA as not being a immediate threat

The aggressive manoeuvering is required to give the tracking radar difficulty in tracking aircraft through the manoeuvres The timing to start this 3D manoeuvering should start not later then 0 5- 1 5 sec of AAA being fired (the earlier the better), depending on range form AAA

The countermeasures should be used in conjunction with the 3D manoeuvering and start simultaneously (0 5- 1 5 sec of AAA being fired (the earlier the better))

The start of the recovery requires high precision The recovery should start within 1-2 sec or +300ft to -0ft from planned recovery The aircraft needs to be recovered in straight and level flight no lower

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then 100 ft AGL

Physical action(s) required to achieve goal:

Look out

Look at displays

Move stick to manoeuvre aircraft aggressively in 3-D

Adjust throttles to achieve desired airspeed

Pull back on stick to achieve desired g loading

Push the Chaff panic button with left hand (if required)

Move C/F switch backward with left thumb (if required)

Move stick sideway to Roll aircraft wings level

Pull back on stick (to load g) to recover

Level of precision/accuracy required to perform the preceding action(s):

High

The level of attending required to look at displays and look out is approximately 0.5-1 sec

Lift vector set +/- 15 deg of roll
Power setting within appropriate range (MAX, Mil, Sub MIL, Idle)
Pull g @ +/- 1 g
Dispense Chaff at appropriate time +/- 1 sec

Type of feedback required to know that goal has been achieved:

Visual, Cognitive

Source of feedback required to know that goal has been achieved:

Visual
HUD
RWR

Factor(s) that influence the achievement of the goal:

Speed / Energy
SA
Proximity to the ground
Threat location (azimuth from which the AAA comes from)
Distance from threat
Aircraft configuration
Environment
Aggressiveness

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IP Number 7 7 6 3(d) **Goal:** Jettison External Stores **Source Task:** 7 7 3 6(i)

Description:

The pilot reaches down with his left hand and presses the Selective Jettison Button to jettison the pre-selected external stores If a more immediate action is required and the pilot requires to jettison all external stores, he reaches up with his left hand and presses the Emergency Jettison Button to Jettison all external stores

Information required to achieve goal:

Aircraft Operating Instructions. Jettisoning procedures Stores Jettison envelope (airspeed / altitude / g / bank)

Aircraft altitude, airspeed, attitude, speed, bank and g, aircraft configuration

Type of stores on board

Mission objectives/priorities, tactical situation

Source of information required to achieve goal:

HUD Aircraft altitude, airspeed, attitude, speed, bank and g.

SMS display aircraft configuration, type of stores on board

Link 16/MIDS display tactical situation.

Decision(s) required to achieve goal:

Decide if aircraft is within jettison envelope

Decide what stores to jettison

Decide if selective jettison or emergency jettison

Decide to set switches for jettison

Decide to push the appropriate button

Type of reasoning required to achieve goal:

rule

Level of precision/accuracy required for the above type of reasoning:

Medium

Pilot has to reason the type of jettison and what stores

Pilot has to analyse aircraft envelope

Pilot has to select the appropriate button (sometimes difficult to the intense workload at that time)

Physical action(s) required to achieve goal:

Look at the SMS display (if required)

Look at HUD

Arm the master arm switch (for selective jettison, if not already armed)

Reach down with left hand and press the Selective Jettison Button to jettison the pre-selected external stores

or

Reach up with left hand and press the Emergency Jettison Button to Jettison all external stores

Level of precision/accuracy required to perform the preceding action(s):

Low

Both buttons are big and easily accessible

Type of feedback required to know that goal has been achieved:

Auditory, Visual, Psychomotor

Source of feedback required to know that goal has been achieved:

SMS display
HUD

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Visually
Sound of stores being jettisoned
Aircraft movement at jettison

Factor(s) that influence the achievement of the goal:

Type and number of threats
Value of weapons
Doctrine (is it acceptable to jettison anywhere, collateral damage issues)

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14 ABSTRACT

(U) This report marks the third in a series of Human Factors Engineering (HFE) reports prepared for the Defence and Civil Institute of Environmental Medicine (DCIEM) in support of the Directorate of Aerospace Requirements (DAR 5) for the Department of National Defense (DND). The objective of this Information Flow and Processing (IFP) Analysis of the CF18A in the Air to Ground mission is to establish a baseline of information that will be used to assess the impact of Helmet Mounted Display (HMD) and Night Vision Imaging System (NVIS) technologies and the flow of information in the cockpit of the Modernized CF-18A.

This report documents the findings of the HFE IFP Analysis of the CF18A in an Air to Ground Role in accordance with the Statement Of Work (SOW), Public Works and Government Services Canada (PWGSC) Requisition No. W7711-017741. While the analysis follows the general principles and guidelines for HFE as described in MIL-HDBK- 46855 “Human Engineering Program Process and Procedures”, the IFP analysis presented here is non-traditional in that it is not being used to analyze critical mission segments as a whole, but instead it is being used to analyze each task of the six critical mission segments identified in the previous Systems Analysis Report.

The Information Flow and Processing Analysis Report presented here details the background research done, the data collection methodology employed, and the results obtained.

For the purposes of this study, the assumed air vehicle was the post CF18A in its’ modernized aircraft configuration, with avionics subsystems, weapons systems and Defensive Electronic Warfare Suite (DEWS). The assumed air vehicle incorporated the CF18A Incremental Modernization Program (IMP) and Capital Program initiatives described in the Mission Analysis Report, The HFE Group Document # 42-014-001. Although the CF-18A HMD will be an integral part of the CF-18A modernization, for the purpose of establishing an initial reference database, it was not included as part of the assumed air vehicle.

As a separate task, a document will be produced detailing the structure of the Access database employed for the gathering and printing of the data.

This series of reports form a body of knowledge that can be referenced by DND staff and contractors to guide or justify CF-18A design decisions that concern human factors and system performance. This information flow and processing report, in particular, provides valuable insight to analysts about the CF 18A pilot's goals and actions, providing a consistent reference upon which to base judgments on competing design concepts.

15. KEYWORDS, DESCRIPTORS or IDENTIFIERS

(U) CF18; Hornet; Air to Ground; Operations; Information Flow; Information Requirements

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